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Published by McGraw-Hill Company, Inc.

W. H. ONKEN, JR. Editor — HAROLD V. BOZELL Editor

Volume 83 — New York, Saturday, March 29, 1924 — *Number* 13

Coal Surcharge on Residence Load Should Be Abolished

TAXES are regarded by the average man with aversion. He abhors them and seeks to circumvent them. Certainly by no stretch of imagination can taxes be said to be popular. Most of them are paid with misgiving and some are regarded as an absolute nuisance. Travelers using Pullman cars, for example, rebel at the 50 per cent surcharge which the Pullman company collects as the agent for the railroad. Up to date 117 bills have been introduced in the Congress of the United States with the object of abolishing this surcharge, but the Interstate Commerce Commission and the railroads remain adamant. True, it costs more to pull the heavy Pullmans, and the railroads need the income; but from a public-relations angle the reaction is harmful to the railroads. The same may be said of coal surcharges on the electric bills of residential consumers. However justifiable the coal surcharge may be, it irritates the ultimate consumer and as a matter of public policy might be abandoned without detriment to the utility. Power and commercial lighting contracts fall under a different classification, and coal surcharges on power contracts certainly can be defended. The principle may also be defended in the case of the residential consumer, but the amount of money involved is so small and the evil consequences are so great that expediency would suggest the abolition of coal surcharges where these customers are concerned. If a company must have the income, let it apply to the commission for an out-and-out increase in rates.

The Whitewashing of the Hydro-Electric Power Commission of Ontario

THE whitewashing of the Hydro-Electric Power Commission of Ontario by the Gregory commission of inquiry appointed by the Drury government was to be expected. Change in government in Ontario came as a result of change in sentiment, and it was but natural that the commission of inquiry should take cognizance of it. Besides, the chairman of the Hydro-Electric Commission, Sir Adam Beck, is a popular idol, occupying the place in the hearts of the people of Ontario that Henry Ford does in the hearts of the people of the United States. Such persons are privileged. They are looked upon and treated as demigods and hence can lightly regard the laws and customs which hamper the average man. To remove them, or to discredit them in the popular mind, is exceedingly difficult. They have so large and devoted a following that no political party willingly seeks to antagonize them.

The facts regarding the Queenston-Chippawa development, however much they may be glossed over, still remain, and the engineers of the Gregory commission found what W. S. Murray, Hugh L. Cooper and other engineers discovered—an exceedingly great disparity between estimated and actual costs. As the ELECTRICAL WORLD has stated on numerous other occasions, the Queenston-Chippawa development was wonderful in conception. It utilizes the total drop between Lake Erie and Lake Ontario, and thus is enabled to generate twice as much electricity from the same amount of water as the earlier developments made nearer Niagara Falls. But, and this cannot be reiterated too often, an excellent design may be rendered economically valueless if built at an unreasonable cost. That epitomizes the Queenston-Chippawa case. It is superpower robbed of all its advantages, and it shows how ill equipped government or a governmental agency is in carrying out a plan that private industry is better able to perform.

Electric Thunderstorm Field Researches

A FEW weeks ago (February 2, 1924) the ELECTRICAL WORLD printed an article by Dr. H. Norinder of Sweden on "Electric Thunderstorm Field Researches," on which it commented editorially at the time. Still more recently (March 15, 1924) E. E. F. Creighton made in these columns an interesting contribution to the subject. Much value attaches to Dr. Norinder's research into the nature of atmospheric electrical disturbances in Sweden, carried on by installing specially insulated aërial lines and recording, both automatically and otherwise, the potentials and vertical potential gradients induced on these lines by thunderstorms in the vicinity. It appears that all of the voltage disturbances which he has recorded were of the non-oscillating type. He therefore inclines to doubt whether lightning discharges are ever oscillatory. Moreover, on the assumption that lightning is a non-oscillatory discharge, he suggests that high-frequency electrical discharges occurring in apparatus connected to overhead lines may be due to ruptures of insulation, say at a horn gap, which in a local circuit of low resistance may set up powerful and destructive oscillations. He thus inclines to the opinion that lightning protection for aërial line systems may best be obtained by reinforcing insulation at all points where a rupture might be likely to occur and by dispensing altogether with horn gaps or lightning arresters.

Whatever opinion may be held concerning Dr. Norinder's conclusions, it must be admitted that the general approach which he adopted is sound; namely, that how to protect open-wire lines against lightning damage can be learned best by steadily maintained observation and experiment. It may never become possible to banish completely the danger of breakdowns in service due to lightning, but there is hope of reducing the danger to a satisfactory minimum and also of reducing to a minimum the cost of the protective devices. This result may be looked for from patient

research in the field and in the laboratory. Dr. Norinder's methods are in the right direction.

However, it is unsafe to generalize so soon from the Norinder results. There is a peculiar freakishness about lightning that makes it unfit for hard and fast conclusions. There are evidences that at least many lightning discharges between clouds, or between a cloud and the ground, are non-oscillatory, as though the resistance in the discharging circuit was above the limit permitting of oscillation, and strong opinions have been expressed in favor of that belief. On the other hand, there are also evidences that some lightning discharges are oscillatory, or at least have a steepness of wave front corresponding to the oscillatory type. It is, perhaps, unsafe to take up as yet an uncompromising mental attitude upon the question. Many more observations will probably have to be accumulated and compared before an impregnable opinion can be attained. This at least can be agreed upon: the data reported by Norinder favor the view that lightning disturbances are non-oscillatory, and that if a high-tension transmission line is subjected to disturbances of such type, the surges produced in the line are likely to be non-oscillatory. This does not mean that lightning arresters should be discarded, but merely that they should be installed in such a manner as to avoid setting up high-frequency local oscillations if they should discharge.

Curiously enough, as the voltage employed on transmission lines rises with the development of the art of insulation, the danger from lightning does not seem to rise in like measure. One reason is that the line conductors come to be operated not far below the corona-forming voltage limit. If the voltage rises markedly, owing to a surge or to a lightning disturbance, the lines find an automatic relief valve instantly in corona, which does not necessarily involve any flashing over or pursuant arc.

The views expressed by Mr. Creighton represent the viewpoint of the power-transmission engineer. His duty is to provide the best protection against much-dreaded interruption of service, such as may be caused by what Mark Twain characterized as "atmospheric foolishness." The best protective apparatus that experience has shown to operate must be installed until there is convincing evidence of its being unnecessary.

Make the Relays Speak for Themselves

RELAYS, like watches, are useful only when in operation, independently of the number owned. Unlike watches, however, relays have no "tick" to indicate that their internal mechanism is functioning. Far too many of them are merely mounted on machines and switchboards, observed with awe and trusted to be on the job at all times. The failure of a relay to function should be guarded against, and it would seem feasible to incorporate in it inexpensive signal or indicating devices which would show its condition to an attendant. It might, indeed, prove possible to incorporate a current-indicating device in the relay, particularly in the induction types, and this would incidentally remove the necessity for some of the many indicating meters in cases where precision is a secondary consideration. In addition, lights or other signals might be used to indicate that the potential circuits of relays are energized and ready to operate when called upon, and with watt or reverse-energy relays phasing and energy direction indicators could well be used.

Some relays of this general type have been made already, and the line of attack seems to offer many promising features for insuring more reliable service. The main object is to have the relay tell visually that it is ready for service when called upon.

Establishing Unit Power Costs for Industrial Operations

THE possibility of developing reliable data on power costs for general application to industrial plants manufacturing virtually the same product is seen in the survey of conditions in twenty cotton mills which appears on page 621 of this issue. While many manufacturers are prone to consider their particular plants as individual cases requiring special treatment, the comparison of operating data from these mills shows that it is fairly safe to assume certain average figures for rough estimating costs. There are certain fundamental elements which can be accurately determined as affecting costs, such as the decrease in unit cost as the size of the mill is increased, long-hour operation and type of drive used.

Information of this kind is of inestimable value to the central-station power engineer when he is assured of its accuracy and where all the elements affecting total cost are set forth as has been done with these mills. Care must be taken, of course, in applying any average figure to a specific case, to be sure either that conditions in the plant in question are almost identical with those of the average case or that proper allowance has been made for all factors which may tend to raise or lower total costs above or below the average figure.

Cleveland's 66-Kilovolt Underground Cable

ANNOUNCEMENT of successful tests on the 66-kv. underground cable which has been installed at Cleveland marks a notable step in underground transmission development in this country. A few years ago all eyes were on the climb in voltage for overhead transmission, each step being hailed properly as an accomplishment of note. Predictions were freely made that the limit had been reached, first at 60,000 volts, then at 80,000, then at 110,000, but constant pursuit through research and experiment has, each time necessity for a higher voltage arose, resulted in raising the practicable voltage to meet the requirements. Today, with 220 kv. an operating success, thus solving the present problem of transferring bulk energy great distances, major interest in increasing operating potentials has shifted to the problem of transferring large blocks of power through the ever-widening metropolitan areas, where public sentiment, if not physical limitations, forces the transmission underground.

The discussion of limits of practicable underground voltages is similar to that which occurred with reference to overhead voltages. The development will doubtless be a step-by-step one, as it was in the other case. The present increase to 66,000, practically a doubling of any successful existing practice in this country, is therefore a substantial accomplishment. It is, of course, too early yet to record successful operation, but it is not to be doubted that 66-kv. operation will be successful. The experiences in Cleveland will

be watched with keen interest by the entire electrical fraternity. Meanwhile, when there is so much talk of European cable quality, it is a justifiable satisfaction, if not pride, that this cable to carry about 30,000 kw. at 66 kv., three-phase, is an accomplishment of American manufacture.

Assuring Economical Transformer Operation

ANY engineer charged with the correct operation of distribution transformers soon finds that he must give definite attention to several things:

First, he must avoid burn-outs due to overloads. These not only mean loss of equipment but the impairment of service, which is generally more important.

Second, he must insure operation during the peak-load hours as close as possible to the maximum safe load of the equipment.

Third, having predicted as intelligently as possible the growth of the territory served, he must plan transformer loading so that the number of replacements of transformers on the lines to meet increasing loads will not outweigh in cost the savings due to operating at high load during the peak. That is, applying the test of minimum annual charges over a period of years to the transformer investment, he must plan the loading at the time of installation in such a way that the fixed charges and the losses on the system added to the cost of replacements with larger sizes, of changes in location and of new transformers will result in the over-all maximum economy. This involves making careful predictions of the normal growth of load for a number of years, basing these predictions on the experience obtained from previous years and on the best judgment available. It also involves a knowledge of the load factor and the shape of the load curve to which the transformers are subjected and a knowledge of the permissible overload on these transformers based on these operating conditions. The latter can, if necessary, be obtained from tests that simulate the actual duty of the equipment.

Evidently constant knowledge of what transformers are doing on the line is required to accomplish this result. The problem is therefore to obtain this information in the best possible manner. In general, distribution systems have grown rapidly and with comparatively little attempt to meet ideal conditions, so that it can be fairly said that nearly everywhere there are many transformers actually overloaded—carrying loads on the peak higher than are safe—and there are also many transformers that are carrying on the peak only a fraction of what they can carry safely. Two opposite conditions are therefore prevalent—overloading and underloading of distribution transformers. The operator is interested in finding both these conditions. Both require attention if quality of service and economy of operation are sought.

Overloads can be found by spot tests made with portable ammeters during periods of heavy loads, by recording ammeters, by demand indicators, by recording thermometers or maximum indicating thermometers and by some kind of a danger signal operating either at a given current or at a given temperature. The proper use of an indication based on a current reading requires a knowledge of the relation between the current, the shape of the load curve and the hot-spot temperature as affected by the outside temperature. The proper use of an indication based on a temperature reading requires the knowledge of the temperature gradient between the safe hot-spot temperature and the place at which the indicator is installed and a knowledge of the effect of the outside temperature on this gradient. With such information a critical temperature can be determined which can be read on the recording thermometer or at which the danger signal can be set. From the experimental work done so far it would seem that a danger signal operated by a given temperature would be the most readily developed into a cheap, reliable and convenient indicator. It has the advantage of giving a direct indication of the high-temperature condition that must be avoided.

Underloads can be found by spot tests made with a portable ammeter during the hours of heavy loads, by recording ammeters, by recording thermometers or recording temperature indicators. However, the knowledge that a transformer is underloaded is not sufficient to determine whether the condition should be remedied or not. If the underload is great enough, it will be advisable to replace the transformer with a smaller one or make some other change in the distribution system. Otherwise it will be best to let the transformer remain in place, expecting it to meet the natural increase of load. The actual load at the time of peak must therefore be known. This will eliminate the use for this purpose of instruments controlled by temperature because of the practical difficulty of determining actual loads by a temperature reading, which would involve taking into consideration core loss and copper loss heating—a constant and a variable factor—ambient temperature, load factor and the shape of the load curve. A low temperature reading would indicate underload, but it would not indicate actual load unless an instrument of great accuracy and range were used.

Make Present Installations Adequate

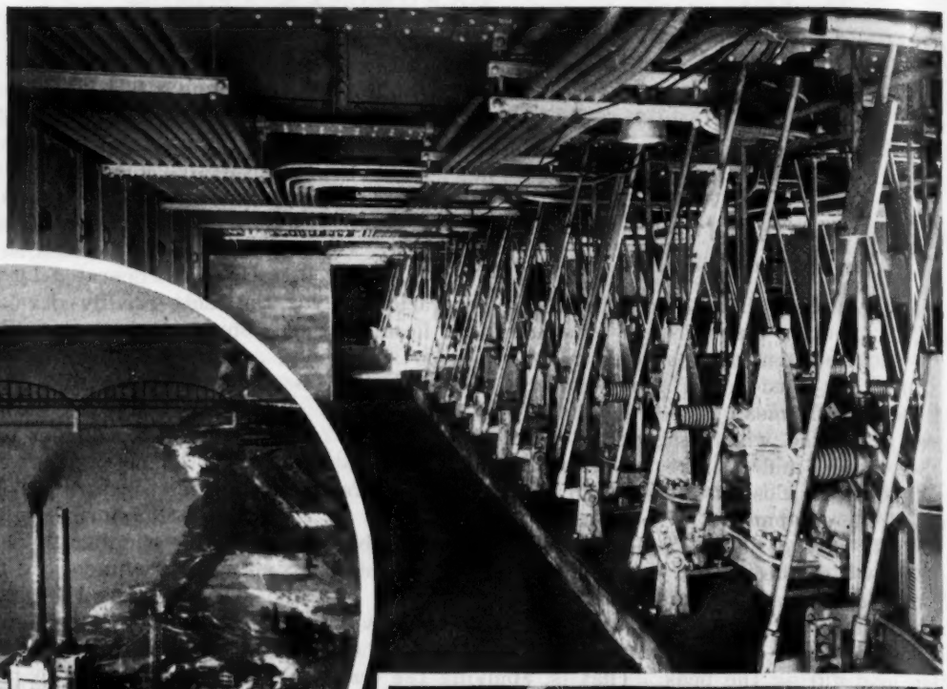
IT HAS been said that the best place to sell neckties is on Fifth Avenue or Michigan Boulevard, where the best-dressed crowd is found—on the general principle that "clean people use more soap than dirty ones." If this is true, while there should be no faltering in the drive to spread electric service to all possible extent, a great market for electric wiring should be found among the millions of connected homes that are not adequately wired, and the greatest field for appliance sales should be those households where only a flatiron and a toaster are in use.

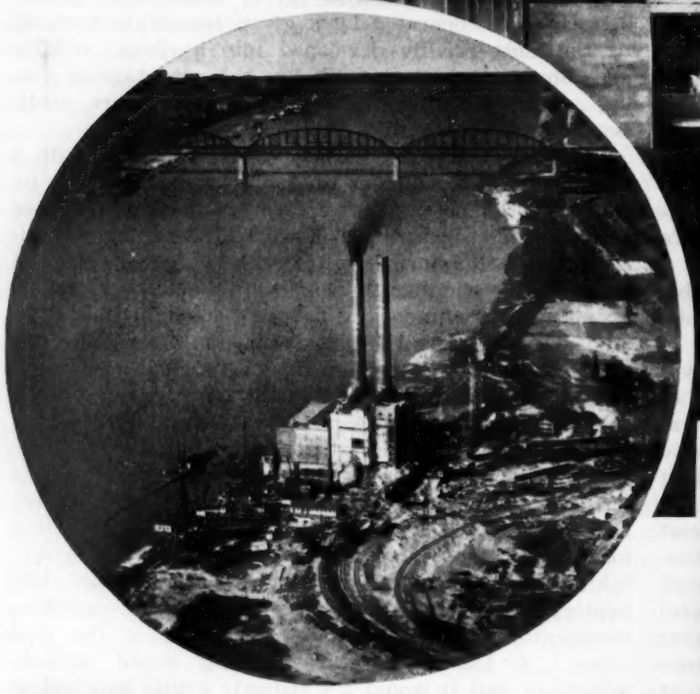
There are some central-station companies that carry on their letterheads and envelopes the question, "Is your house wired?" Since the bulk of their correspondence goes to wired homes anyway, would it not be well to have the importance of the "partial customer" a little more in mind and make the query to him, "Is your home adequately wired?"

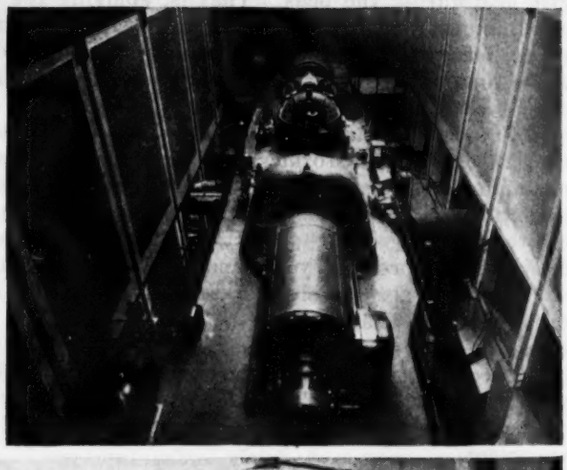
Much has been said among electrical men about adequate wiring and adequate appliance equipment, but very little has been actually done to develop it. Here is really a fallow field. The missionary work is done. Bills are going to these households every month. Sales of additional equipment to these present customers will bring a higher rate of profit than from the newly wired homes. More effort can well be applied by both central stations and contractors to make these present installations more nearly adequate.

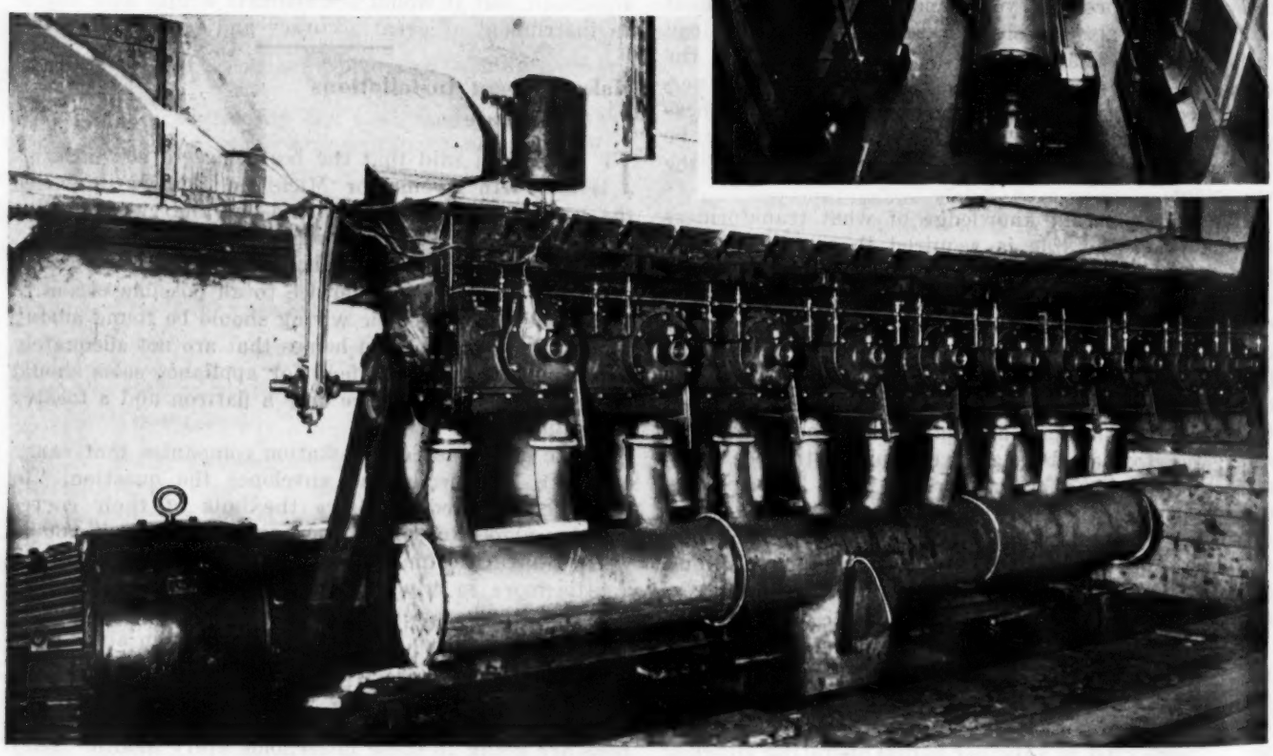
Cahokia—

St. Louis' New Power Station









IN CIRCLE, airplane view of first section of plant, now operating; the second section is under construction.

At top, the circuit breaker and disconnect operating mechanisms, located below the circuit breakers and above the main control room. Motor-operated mechanisms actuate the circuit breakers and are mechanically interlocked with the hand control for the disconnects.

In middle, right, general view of the turbine gallery; note the end to end arrangement of the turbines. At bottom, pulverized fuel feeders for one boiler showing arrangement for group drive.

Pulverized-Fuel, Isolated-Phase Station—I

Cahokia Plant Involves Also Underground Coal-Handling Facilities, Coal-Preparation Plant Integral with Station, Unit Layout of Station and Unusual Condenser-Floor and Foundation Plans

Some Individual Features of Cahokia Power Plant

Pulverized fuel used in furnace.

Pulverized fuel installation is in the same building as the boilers, but isolated by fire walls and floors.

There is an interesting particular sectionalization of the plant.

The building is placed out in the river, thus avoiding extensive tunnels for circulating water.

The foundation has special features and the foundation waterproofing is of interest.

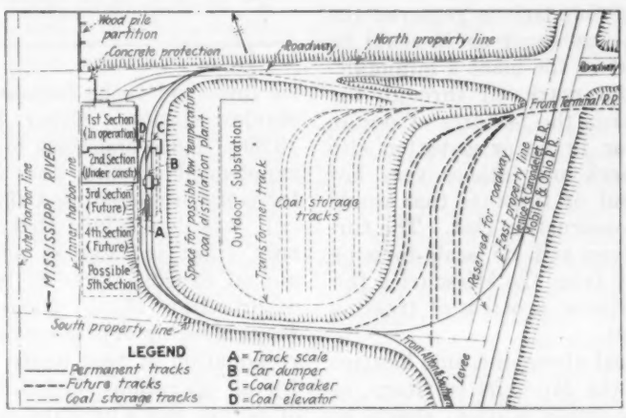
On the electrical side the phases are isolated vertically, with mechanisms at the bottom and circuit breakers above. The operating room is at the bottom rather than in the usual location at the top of the plant.

TWO much-discussed features—namely, powdered-fuel combustion and isolation of phases—have been combined in another large and important generating station — the Cahokia plant of the Union Electric Light & Power Company — which has been placed in operation and has been carrying load since Oct. 15, 1923, thirteen months after the first foundation pile was driven. It was called into being by the rapidly growing load in the territory served by the Union Electric Light & Power Company, which has doubled its output in five years. Despite the existence of the Ashley Street generating station and its connection with the Keokuk hydro-electric plant, the load increase could not be cared for without additional local generating facilities, and these had to be obtained at about 30,000 kw. a year.

In considering the location of the new plant the same general factors had to be taken into account that determine the choice of every steam-plant site—namely, the most strategic reinforcement of the existing system, convenient coal supply and adequate condensing water. In this company's case 25-cycle power was already being received from the north from Keokuk. Supplementing this was the 25-cycle and 60-cycle Ashley Street station in the northeastern part of St. Louis, 2½ miles north of Cahokia on the Mississippi. Energy was being supplied to an electrically interconnected system around St. Louis in a territory bounded on the north and east by the Missouri and Mississippi Rivers respectively and on the south by Washington, St. Clair and De Soto, Missouri. The Union company serves sections in other parts of Missouri, but they are not connected with the system under consideration at the present time. Recently acquired properties on the east side of the Mississippi River had extended the eastern boundary to a line approximately through Alton, Edwardsville, Belleville and Millstadt, Ill. Not only was the load growing beyond the limits of existing generating facilities in St. Louis, but a fertile field for industrial load was opened by the Illinois territory acquisition. Consequently, for strategic reinforcement of the system as a whole, existing and prospective load conditions alone indicated the need of a new generating plant somewhere near St. Louis. Because of circulating-water demands the plant had to be adjacent to a large body of water. The Mississippi affords an adequate supply for any size station that can be imagined.

Coal supply was a critical influence as regards which side of the Mississippi to select, since the west side of the river has always been under the handicap of having to pay 29 cents per ton bridge toll for coal from the east. This toll magnifies in significance when it is considered that it adds about $350,000 a year to operating expense when the amount of coal required in that time by the ultimate station is considered. The company already owns a coal mine on the east side of the river about 75 miles from East St. Louis, coal from which may be estimated to cost $2.50 per ton over the life of the plant. The Belleville district, only 20 miles from East St. Louis, affords another source of poorer-grade coal upon which the design of Cahokia was based. An analysis of a large number of samples of the Belleville coal taken at different times shows the following content: 9,945 B.t.u. (as received), 12.47 per cent moisture, 37.4 per cent volatile, 45.91 per cent fixed carbon, 16.69 per cent ash, 5.04 per cent sulphur, 18.56 per cent iron in ash. The ash fuses at about 2,000 deg. F.

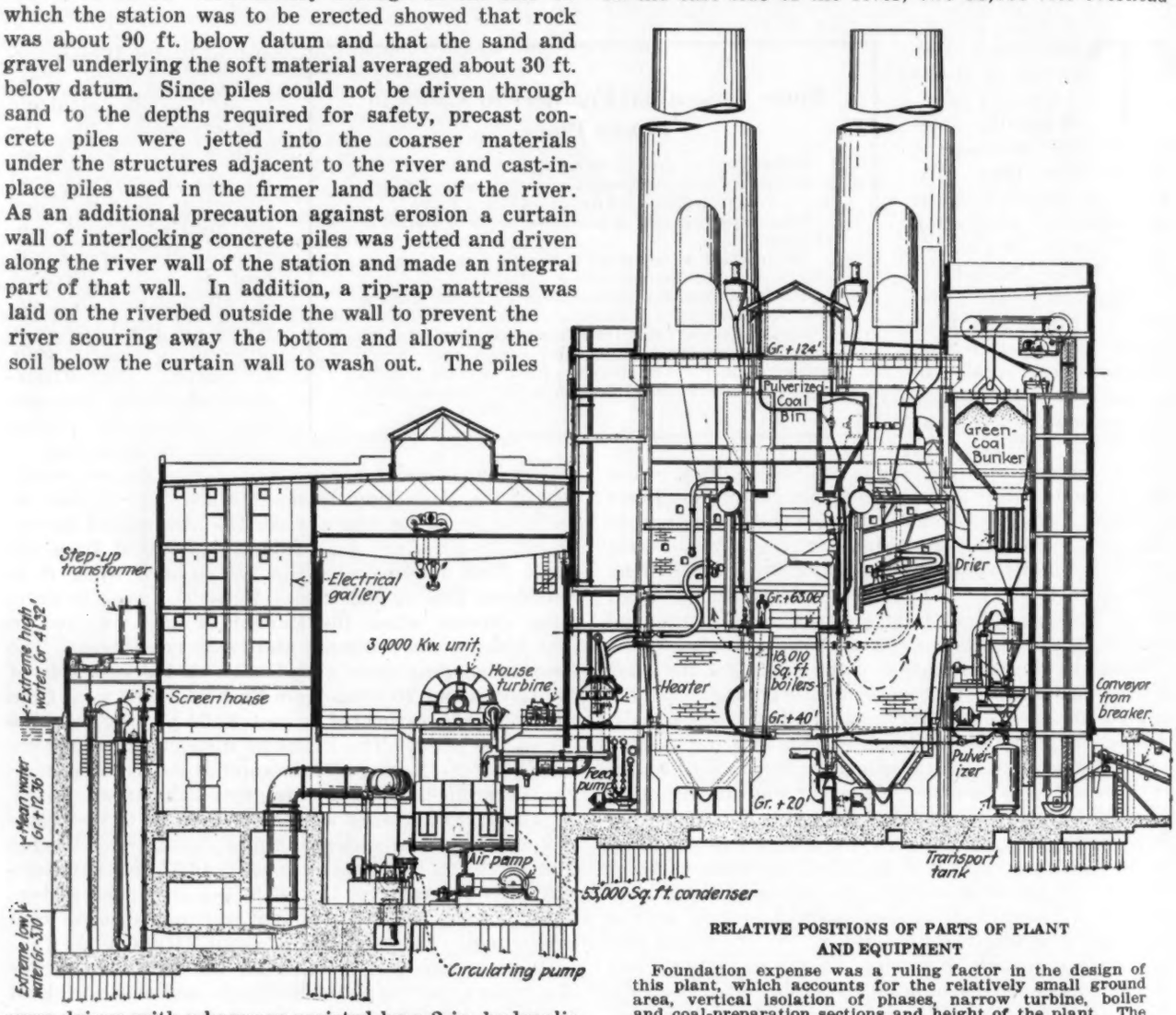
Hence a site was selected on the east side of the Mississippi, just opposite St. Louis and south of East St. Louis, Ill. This particular site was chosen because it served as a point from which transmission lines could radiate to the newly acquired territory and because it is only a few thousand feet from the load center of the Missouri territory. Because of Illinois state requirements the plant had to be owned by an Illinois corporation, so the Union Electric Light & Power Company of Illinois was formed as the owning company and the plant leased to the Union Electric Light & Power Com-



PLAN OF STATION SITE

pany (of Missouri) for thirty-five years at an annual rental of 10.8 per cent of the total investment including depreciation.

To use this site imposed certain obstacles, but they had to be accepted in view of the paramount importance of the three factors discussed. The outstanding problem was to provide on very soft ground a substructure which would withstand a maximum change in river elevation of 44 ft. Preliminary borings of the site on which the station was to be erected showed that rock was about 90 ft. below datum and that the sand and gravel underlying the soft material averaged about 30 ft. below datum. Since piles could not be driven through sand to the depths required for safety, precast concrete piles were jetted into the coarser materials under the structures adjacent to the river and cast-in-place piles used in the firmer land back of the river. As an additional precaution against erosion a curtain wall of interlocking concrete piles was jetted and driven along the river wall of the station and made an integral part of that wall. In addition, a rip-rap mattress was laid on the riverbed outside the wall to prevent the river scouring away the bottom and allowing the soil below the curtain wall to wash out. The piles were driven with a hammer assisted by a 2-in. hydraulic jet of 250 lb. pressure at the end of the pile.



RELATIVE POSITIONS OF PARTS OF PLANT AND EQUIPMENT

Foundation expense was a ruling factor in the design of this plant, which accounts for the relatively small ground area, vertical isolation of phases, narrow turbine, boiler and coal-preparation sections and height of the plant. The superstructure cost had to be balanced against the substructure to minimize the total cost. Details of each section are shown more completely in other views and drawings.

Because of the cost of the foundations required the ground area had to be made as small as it could be in order to make the total cost of the plant a minimum. This requirement has left its mark all through the plant, as may be seen later when the features of design are considered. The variation in water elevation also required setting the condensers and intakes very low and influenced an arrangement of turbines that would minimize the condenser-pit construction cost. The turbidity of the Mississippi River and its scale-forming constituents (acquired largely from the Missouri a few miles north) impose the additional problem of treating the water for various purposes.

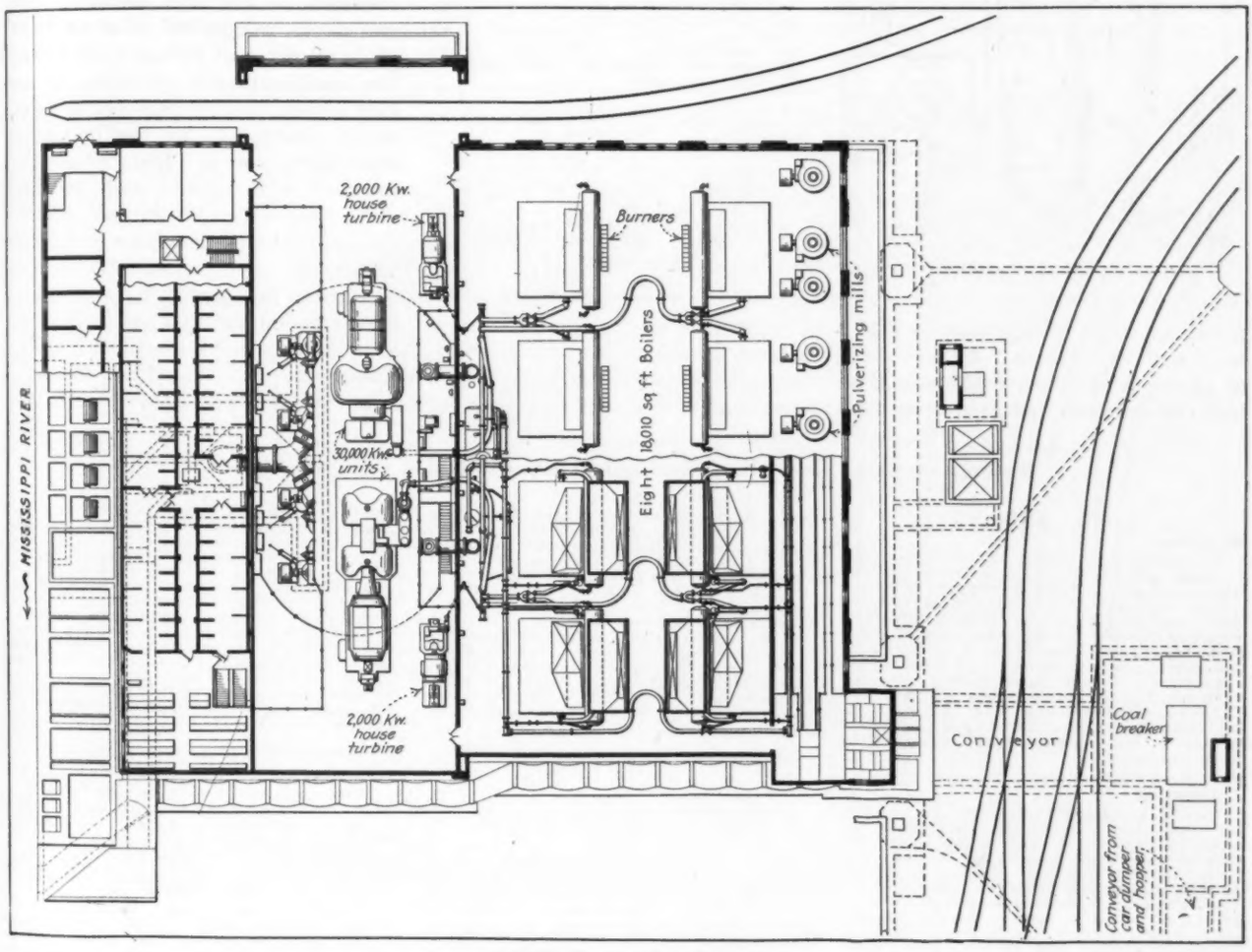
Considered from an electrical viewpoint, this location required that the feeders to the Missouri territory, as well as tie feeders to Ashley Street station, should be installed under the Mississippi River. The river span at this point is about 2,500 ft. A voltage of 33 kv. had to be utilized for this purpose because of the amount of power that had to be transmitted. Twelve three-conductor 350,000-circ.mil submarine cables designed for this voltage are already installed in the bed of the river, and six more will be added during 1924. Because of the inadequate generating facilities of the Illinois distributing system in the territory acquired on the east side of the river, two 33,000-volt overhead tie lines had to be installed to connect with the Winstanley station. Other lines of various voltages—13,800, 33,000 and some higher voltage—will be used to supplement existing lines in transmitting power to the territory surrounding Cahokia.

It was determined that if the highest over-all economy (that is, highest average efficiency with lowest annual expense) was to be obtained, the major paths of procedure should involve powdered-coal combustion, stage bleeding of prime movers, motor-driven auxiliaries, reclamation of heat losses and minimum labor expense for all operations, including coal handling. Reliability of service was a primary consideration as will be pointed out later. Some of the reasons for striking off the

beaten path to secure better continuity of service and greater over-all economy will be considered specifically, along with the ways in which some of the outstanding ideas were executed to attain the end sought.

The reasons for adopting powdered-coal combustion and the particular manner of isolating of phases may be interesting to those who have not yet determined for themselves the relative economic field of these recent power-plant improvements.

Considering powdered-coal combustion, the outstanding factors which dictated its adoption in this plant were its ability to burn any grade of coal, flexibility of operation, including quick pick-up of load, greater efficiency, with the best forced-draft chain-grate stoker tested, as well as other advantages already referred to. On the basis of bids submitted by stoker and powdered-fuel equipment manufacturers as well as on the relative building space required it was also found that there would be no additional investment. Including the fixed charges on this investment and the operating and maintenance figures secured from investigating the reports of powdered-coal users, it will be recalled that it was calculated that $60,000 to $75,000 could be saved yearly in the initial section at Cahokia by burning powdered coal. The actual installation figures, now that the plant is erected, show the investment cost to be about a



FLOOR PLAN OF FIRST SECTION

The relatively small ground area for a 60,000-kw. plant is again evident here. The success attained was greatly facilitated by the unit layout, which also had the advantage of permitting the construction of a plant with the least investment for future requirements. The plant is, none the less, readily adapted to extensions and other arrangements which developments may prove desirable. The arrangement of boilers and turbo-generators with their mechanical ends adjacent over a single condenser pit afforded one method of minimizing substructure and piping investment and in addition adds to operating convenience.

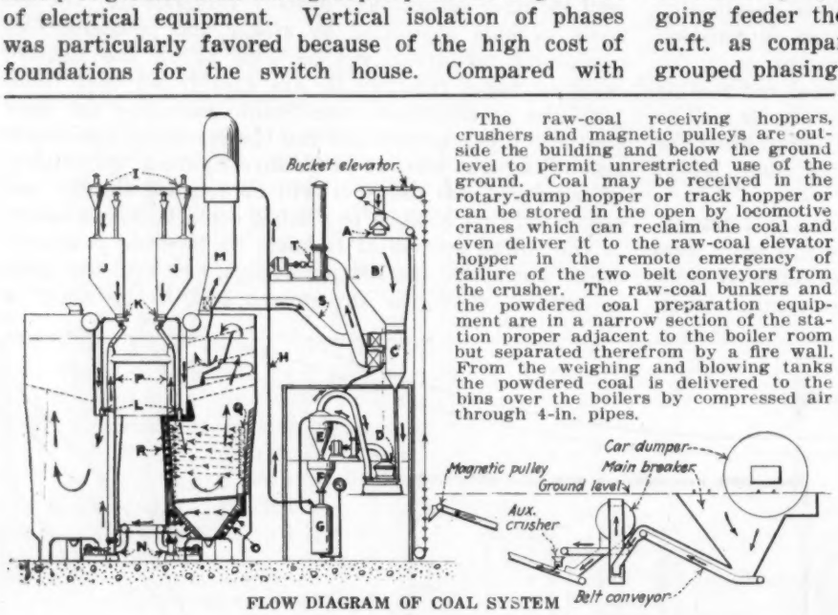
saving in maintenance expense, saving in ash disposal and elimination of banking losses. These advantages were checked before stoker firing was dropped by investigating the experience with existing powdered-coal plants and by conducting tests with sixty carloads of the Belleville coal under three types of boilers and with one modern underfeed stoker, three forced-draft chain-grate stokers and a powdered-fuel furnace.

The results of these tests, which were conducted under operating conditions and reduced to a common denominator of the same flue temperature and other boiler operating conditions, showed about 5 per cent lower coal consumption with the powdered-coal furnace than "fifty-fifty" stand-off comparing pulverized fuel and stokers. This low cost for pulverized fuel was due in part to putting the pulverized-fuel equipment in the same building as the boilers themselves.

In some individual tests it was found that powdered-fuel boilers which had stood six hours with no fires will undergo a pressure drop from 325 lb. to only 225 lb.

Isolation of phases, regardless of the particular method followed, was considered advantageous because it decreases the possibility of phase-to-phase short circuits with a consequent reduction of oil-circuit-breaker duty. Consequently, if circuit breakers selected for phase-to-phase short circuits are chosen, the margin of

safety is greater than with grouped phase arrangements of electrical equipment. Vertical isolation of phases was particularly favored because of the high cost of foundations for the switch house. Compared with grouped-phase arrangement of electrical equipment the total cost was found to be so little more that isolation of phases was considered more than justified. It also had construction and operating advantages which will be taken up specifically later. In cubic feet per outgoing feeder the vertical isolated phase showed 6,640 cu.ft. as compared with 10,400 cu.ft. for the usual grouped phasing arrangement.



FLOW DIAGRAM OF COAL SYSTEM

The raw-coal receiving hoppers, crushers and magnetic pulleys are outside the building and below the ground level to permit unrestricted use of the ground. Coal may be received in the rotary-dump hopper or track hopper or can be stored in the open by locomotive cranes which can reclaim the coal and even deliver it to the raw-coal elevator hopper in the remote emergency of failure of the two belt conveyors from the crusher. The raw-coal bunkers and the powdered coal preparation equipment are in a narrow section of the station proper adjacent to the boiler room but separated therefrom by a fire wall. From the weighing and blowing tanks the powdered coal is delivered to the bins over the boilers by compressed air through 4-in. pipes.

Determination of the initial size of the plant was influenced chiefly by the expected power requirements before a second section could be completed and placed in operation. According to past history and a careful study of future requirements, it looked as though generating facilities of 60,000 kva. would be required in the first section. The station is calculated on a basis of 40 to 50 per cent annual load factor. The maximum size of units to use was determined in this plant, as in many others, (1) by the maximum generator rating that could be dropped momentarily and the load still absorbed by the system, (2) by the largest turbo-generator obtainable which had given satisfaction in operation, but chiefly by abilities of manufacturers to deliver promptly. Single-shaft units were favored to allow a layout having a smaller foundation area. The maximum size which could be considered with these requirements in view was 30,000 kw.

Ratings of Some Important Mechanical Equipment at Cahokia Station

COAL HANDLING

Raw Coal:

Weighing—one Buffalo track scale; unloading—one 90-ton Link-Belt rotary car dump and one open-track hopper; crushing—one 350-400-ton Bradford coal breaker and one 50-60-ton American Pulverizer ring-roll crusher for breaker rejects; magnetic separators—two 24-in. x 38-in. Ding; conveying and elevating—Link-Belt apron conveyor and belts and bucket elevator (300 tons per hour); crushed-coal bunkers—1,600-ton concrete; storing and reclaiming—one Brown and one American Hoist locomotive crane, and one American saddle-tank locomotive.

Pulverized Coal—Preparation and Handling:

Driers—ten Lopulco flue-gas type, reducing from 12 to 5 per cent moisture; exhausters for driers—two 60,000-cu.ft.-per-minute Sturtevant (driven by 125-hp., 425-r.p.m. induction motors); pulverizers—one 15-ton (driven by 200-hp. belted motor) and eight 6-ton (direct-connected to 100-hp., 450-r.p.m. induction motor) Raymond mills; coal weighing and transporting—Quigley Transport system and Howe scales; powdered-coal bins—eight at 75 tons each, concrete; feeders and burners, ten Lopulco feeders and burners per boiler.

BOILERS, SUPERHEATERS, ETC.

Boilers:

Eight Babcock & Wilcox cross drum; 38 tubes wide and 20 tubes high (4-in. tubes); heating surface—18,010 sq.ft. per boiler or 2.4 sq.ft. per kilowatt.

Superheaters:

B. & W. convection type above sixth row of boiler tubes with 2-in. No. 10 tubes; heating surface—4,070 sq.ft.

Soot Blowers:

Eighteen Diamond elements.

Regulators:

Two Copes per boiler.

FURNACES

Volume—11,440 cu ft. per boiler, 1.5 cu.ft. per kilowatt and 0.615 cu.ft. per square foot of heating surface; refractories—Laclede-Christy and Evans & Howard firebrick and Walsh refractory tile; insulating brick—C-22 Celite and Silocel; suspended arches—four Detrick and four Liptak; ash gates—two Allen-Sherman-Hoff per furnace; ash handling—Allen-Sherman-Hoff hydraulic sluice, two 6-in. centrifugal manganese steel-lined Morris Machine Works dredge pumps (direct-connected to 75-hp., 1,200-r.p.m. induction motors); water screens above ash pit and on back furnace wall—4-in. tubes with 580 sq.ft. heating surface per boiler; primary air fans, four 20,000-c.f.m. Sturtevant fans (driven by 100-hp., 1,200-r.p.m. induction motors); combustion control—Bailey (two furnaces only); gas, uptakes and flues—Connery Gunite-lined steel plate; stacks—325-ft. tile-concrete Wiederholdt (19 ft. inside diameter at top), supported on superstructure.

HIGH-PRESSURE PIPES, VALVES AND COVERING

Piping:

High-pressure steam, boiler-feed and blow-off piping and fittings (Midwest).

Valves:

Boiler non-return and high-pressure steam-globe (Edwards), high-pressure gate valves (Crane), motor-operating mechanism (Payne Dean), high-pressure boiler-feed gate and check (Chapman), high-pressure boiler-feed globe (Lunkenheimer), atmospheric relief (Atwood & Morrill), seatless Yarway blow-off valves in series with Lunkenheimer gate valves; high pressure (800-lb.) hydraulic standard; steam joints (Sargol); high-pressure boiler-feed joints (Van Stone).

Heat Insulation:

Carey High Temp. and 85 per cent carbonate of magnesia.

PRIME MOVERS, CONDENSERS, HOUSE TURBINES, ETC.

Main Units and House Turbines:

One seventeen-stage 35,300-kva. Curtis (General Electric); one semi-double-flow 35,300-kva. Westinghouse, designed for 300 lb. and 690 deg. Fahr. at throttle; bled at one point each (18 lb. absolute); lubricating oil coolers—Andale and Griscom-Russell; same for house turbines; oil purifiers—600-gal.-per-hour De Laval centrifugal; house turbines—two Westinghouse horizontal, non-condensing, 2,500-kva., 3,600 r.p.m. designed for same steam conditions.

Condensers:

Two 53,000-sq.ft. (1.75 sq.ft. per kw.) two-pass Worthington with 1-in. No. 18 Admiralty tubes furnished by Wheeler Condenser & Engineering Company and Scovil Manufacturing Company, respectively; circulating pumps (1.8 g.p.m. per kw.), two 27,000-g.p.m. and two 33,000-g.p.m. per condenser direct-connected to 250-hp., 385-r.p.m. slip-ring motors; condensate pumps (direct connected to 75-hp. slip-ring motor), two 800-g.p.m. two-stage Worthington per condenser; vacuum pump (driven through silent chain by 50-hp., 600-r.p.m. slip-ring motor), one 33-in. x 24-in. Laidlaw-Dunn-Gordon feather-valve rotative dry-vacuum pump per condenser; sluicegates—eleven Coffin gates and one butterfly valve; intake screens—four 5-ft. x 52-ft. Link-Belt traveling type, driven by 5-hp., 1,200-r.p.m. induction motors with Jones speed reducer.

WATER SUPPLY AND HANDLING

Treatment:

Primary, Graver cold process with calcium hydrate and iron sulphate (600 g.p.m.); secondary, Graver cold process with barium hydrate (600 g.p.m.); chemicals weighed and handled by Strait traveling weigh larry.

Heaters and Deaërators:

Closed heaters—two (Wainright) Alberger floating-head; evaporators—10,000 lb. per hour two-effect Lillie (Sugar Apparatus Manufacturing Company); deaërators—720,000-lb. per hour open-heater Cochrane boiler type.

PUMPS AND REGULATORS

Boiler-Feed Pumps:

Four 750-g.p.m. six-stage Allis-Chalmers, three driven by 300-hp., 1,760-r.p.m. slip-ring motors and one by 200-hp. Terry turbine; regulators—three Ruggles-Klingemann and one Fischer excess-pressure type.

Raw and Treated Water and Make-up Pumps:

Five two-stage 500-g.p.m. Worthington pumps (driven by 50-hp., 1,200-r.p.m. induction motors, for raw, semi-treated and treated waters; make-up pumps—two one-stage 500-g.p.m. Worthington (driven by 20-hp., 1,200-r.p.m. squirrel-cage motors).

INSTRUMENTS FOR MECHANICAL DEPARTMENT

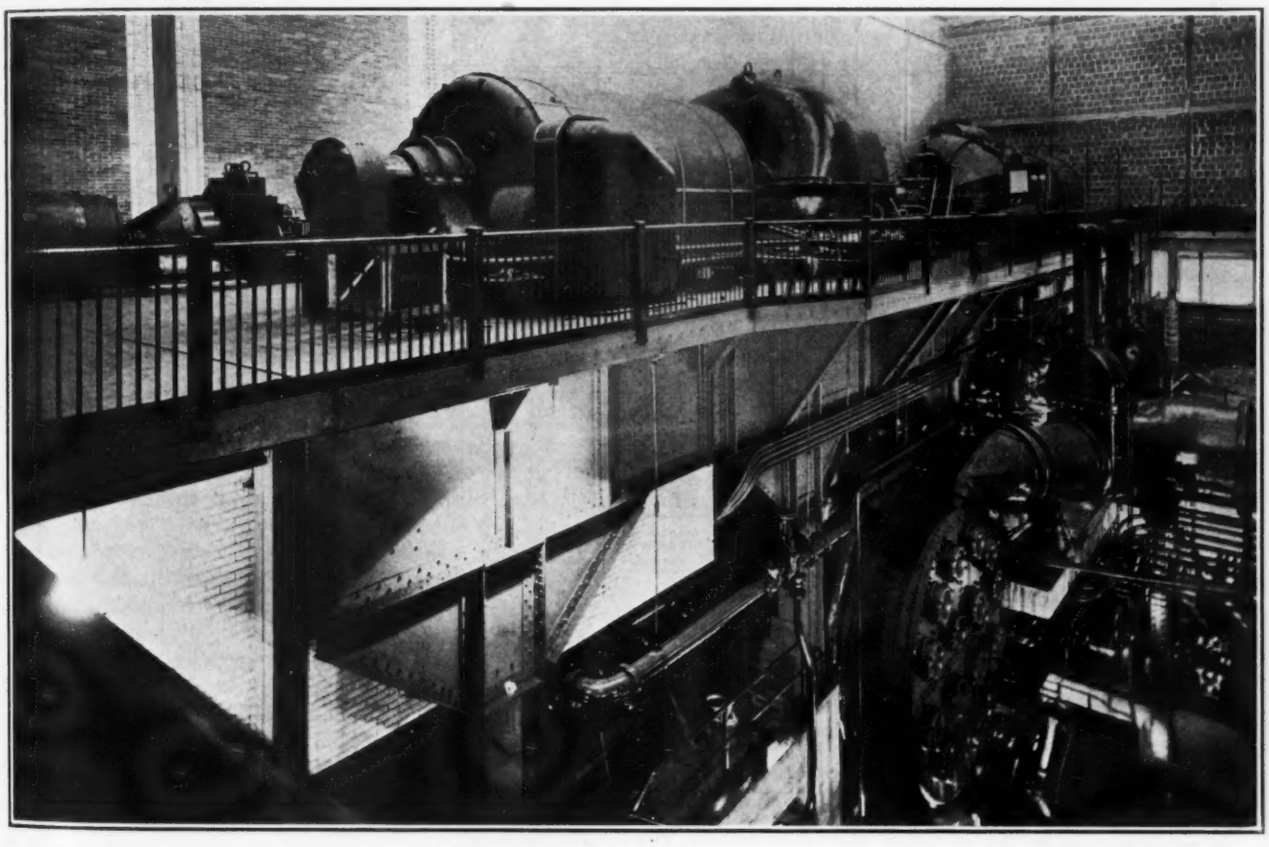
Resistance thermometers—Wilson Maculen indicating and recording; recording thermometers and pressure gages—Foxboro; steam-flow-temperature-pressure recorders—General Electric; recording boiler-feed meter—Simplex; recording steam-flow gas-flow flue-gas-temperature meters—Bailey.

While the total boiler rating required per unit was definitely determined by the size of the turbines and reserve capacity required, the size of the individual boiler units was influenced by the foundation area required, the maximum rating desired in one unit and the size of unit which would allow most economical operation at less than turbine rating. Weighing of these factors resulted in the selection of four 1,800-hp. boilers per turbine mounted on very high furnace settings. The layout adopted is so flexible that stokers could be used if they ever became warranted.

After these sizes of units had been selected and the plant was well under way, turbine manufacturers offered to build 35,000-kw. turbo-generators which would not take much more space than the 30,000 kw. Hence while four sections like the initial would have an ultimate rating of 240,000 kw., the adoption of 35,000-kw. (on order for the fourth unit) will enable making the immediately considered ultimate plant 300,000 kw. This size is not the limit to unit rating by any means, 40,000-kw. to 45,000-kw. units being seriously considered even now. The unit layout of the plant will readily permit a wide latitude of choice in size of units. Development, experience and expansion of the system will determine how much the ultimate rating of the plant will run beyond 300,000 kw., since it is not limited by condensing water.

Aside from the adoption of powdered-fuel combustion and isolation of phases, putting the coal-preparation plant in the same building with the rest of the plant is unusual, the small space occupied being especially noteworthy. Placing all the raw-coal-handling equipment underground up to the point where the bucket elevators rise to the raw-coal bunkers is somewhat unusual. Another feature, dictated by the cost of the foundation, is the small ground area and relative height of the plant. Placing the turbines end to end with the steam ends of each pair abutting over a single condenser pit is an expedient which had several advantages from a foundation viewpoint. The unit arrangement of the plant and provisions to secure safety and reliability of service constitute other features of the plant. The chief advantages of the unit layout selected for this plant are (1) the opportunity to hold the idle investment to a minimum (as in the building and water-circulating system) and (2) facilitating adaptation of plant extensions to new developments.

Considered in its major elements, the plant is laid out with the outdoor transformer bays and electrical gallery next to the river, convenient for attachment to the submarine cables. To the landward are the heavier parts of the plant such as turbine room, boiler-room, coal-preparation section and coal-receiving facilities, located in the order named. As the plant is enlarged it will be extended parallel to the river.



TURBINE GALLERY AND CONDENSER PIT

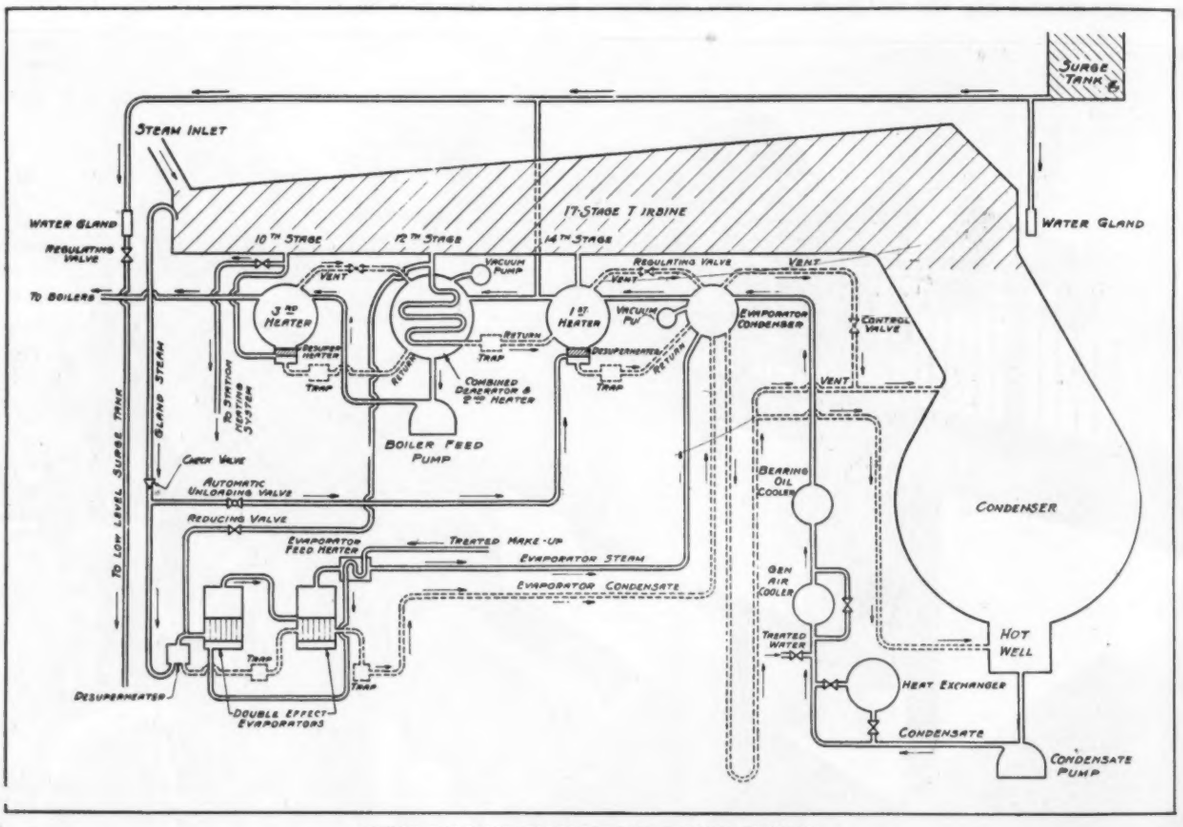
Circulating pumps driven by slip-ring motors are on pedestals at ends of condensers. Hydraulically controlled valves are used in circulating water intake

Very little labor is required to handle coal from the time it is received until it is burned. Coal may be received over the Alton & Southern, Mobile & Ohio, Southern or Terminal Railroads, receiving tracks being provided outside of the station. All coal receipts are weighed on a track scale. Cars that have bottom or side-dump gates may be discharged into a track hopper. Others not so equipped can be unloaded by a rotary car dumper in one and one-half minutes (time from running car on to getting off), or the coal can be put in open storage by locomotive cranes which are also used for reclaiming purposes. An underground-belt conveyor runs under the rotary car dumper and track

hopper to a coal breaker which is supplemented by a crusher, either or both of which may be by-passed if the coal will pass a 1¼-in. ring. From the breaker other underground conveyors transport the coal over a magnetic pulley, which removes tramp iron, into the hopper of a bucket elevator. Placing all the raw-coal-handling equipment underground left the land outside the plant unobstructed for any use required of it. The cost of doing this was no more than building an overhead trestle for the conveyor, partly because the original grade of land was + 28 and this was filled up to grade + 40, so that 12 ft. of these structures was above ground when built.

The bucket elevators previously mentioned discharge on a belt over the raw-coal bunker at the top of the closed hoppers, from which it drops into continuous weighing and blowing tanks. From the latter the coal is forced by compressed air through 4-in. pipes to cyclone separators over the corresponding powdered-coal bin in the boiler room. A reserve coal transport line is run alongside each weighing tank and over the tops of the bins so that coal can be delivered to any bin from any mill. Since the labor is the same for four mills, regardless of size, it is a labor saver if mills larger than 6 tons are used. Already one 15-ton mill is being tried out.

The only trouble experienced with the powdered-coal transport system was due to excessive moisture permitted to remain in the coal. This occurred during extreme cold weather for St. Louis and when the driers



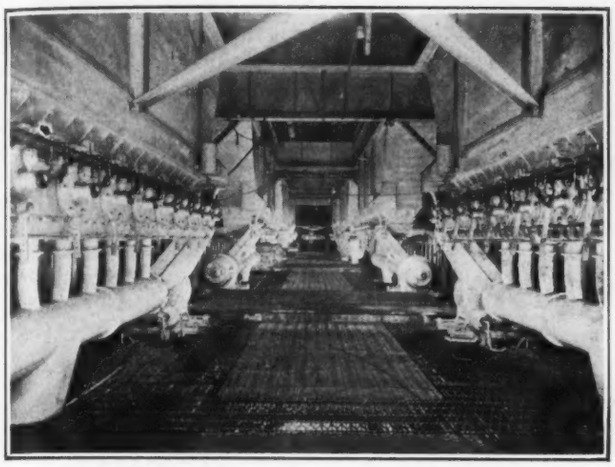
HEAT BALANCE DIAGRAM FOR SECOND SECTION

To permit starting up this station in case all connections with the rest of the system were interrupted, it was considered desirable to use two house turbo-generators, even though prime movers bled at three points were available and could be used without house turbines. In the second and succeeding sections this requirement will have been met by the present house turbines, so no more will be added and the prime movers will be bled at three points and a different heat balance adopted.

coal-preparation section of the plant. This section is only 20 ft. wide and is separated from the boiler room by a masonry wall, passage through which is afforded by rolling-steel vestibule curtain doors, weighted to close automatically. Aside from this construction to reduce insurance premium, a large percentage of the outer wall is fitted with thin glass windows, the upper row being kept open so that any primary explosion would not break the windows and any secondary explosion, which is very unlikely, would lose its force and not harm the building or equipment.

In this section, which is subdivided so that only the equipment for feeding four furnaces is together, raw coal flows by gravity from the bunkers through the flue-gas-type driers to the pulverizer mills. From the mills the coal which has been pulverized is lifted by air suction and blown to collectors and dropped into were not in service. In this experience it was found that it is important to dry the particular coal, then used. to at least 5 or 6 per cent moisture. One of the cyclone separators i.. the pulverizing room and one on the boiler-room roof and one weighing and blowing tank have been covered with 2-in. hair felt to avoid condensation as an experiment, but as a result it seems unnecessary to provide covering on this equipment.

At the top of the boiler room, under the cyclone separators previously mentioned, are the pulverized-coal bins. These are near enough to the flue-gas uptakes to be always warm, but not hot, so there is not much chance of condensation even if air could enter the bin. Condensation as well as the presence of sufficient air to support consumption is minimized by completely closing the bins, separating the air from the coal before it is dropped into the bins and by venting the bins

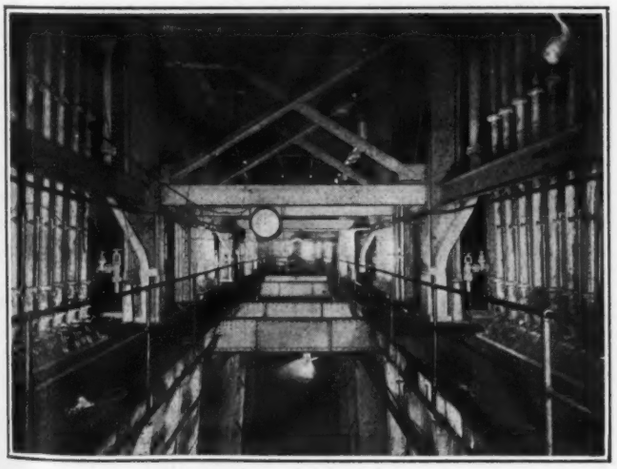


GENERAL VIEW OF COAL-FEEDER FLOOR

Ten coal feeders driven by one adjustable-speed motor through clutches serve each furnace. Fifteen per cent of the air required for combustion aërates the coal to facilitate uniform feed and direction of the flame. Normally all feeders operate at the same speed. When the total feed must be reduced greatly, alternate feeders are disengaged and the remaining feeders regulated. Below the feeders is the primary air duct. Note extensive use of open gratings to facilitate air supply for combustion and to improve ventilation. The burner gallery is immediately below.

through check valves. Even if moisture-laden air does enter, the coal is not likely to clog in the bins because of their steep sides and absence of pockets. Even with the precautions taken to exclude air, care is taken to empty the bins if the corresponding boilers are to be off the line for more than three days. With boilers operating at 200 per cent rating, the bins would normally clear themselves at the rate of about one and one-half times a day.

From the bins the coal drops into spiral-screw feeders (ten per furnace) driven in a group by a variable-speed motor. Each feeder has a clutch so that it can be cut out of service as may be necessary when running at light load. Changes in feed down to a certain minimum per burner are accomplished by varying the speed of the group-drive motor. When this point is reached a few burners are cut off and the remainder operated at higher feeding rates. Periodically the unlighted burners are lighted and the others shut off, to distribute the flames. The primary air (15 per cent



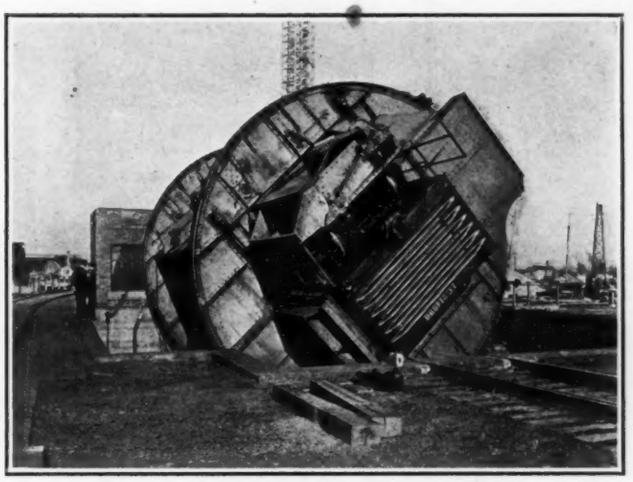
BURNER GALLERY IN BOILER HOUSE

At the bottom of large pipes near the burner tips are dampers which permit changing the admission of additional air. This air helps to direct the flames and incidentally cools burner tips slightly. Normally all burner control is executed from the gallery above. Two levels below, in the basement, are the ash pits and hydraulic sluice.

of that needed for complete combustion) is preheated in passing through the walls of the ash hoppers and then blown to the burner feeders to direct the flame, assist uniform feeding and avoid spurts of coal. Incidentally, it warms the coal slightly.

The burners, which are of the corrugated fishtail type, are mounted vertically, with their long dimension at right angles to the furnace front so the flames will be exposed most effectively to the preheated secondary air (85 per cent of the total) entering the furnace front. Experiments are in progress to ascertain the effect of the angle of the burners on flame distribution.

Very deep powdered fuel furnaces are used, there being 23 ft. from the burners to the water screens at the bottom of the furnace. This gives a flame travel of 56 ft. and a furnace volume of about 11,440 cu.ft. per boiler. This volume and height have been found effective in assuring complete combustion before the long flames from the Belleville coal reach the tube. The furnaces, of which there are four for each turbine served, are arranged two on each side of an aisle, facing each other. Their depth is such that a narrow boiler room (106 ft. total between outside wall column



ROTARY CAR DUMPER IN OPERATION

Will dump car in thirty seconds. Total operation, including running car onto and off dumper, takes one and a half minutes.

centers and 21 ft. 6 in. between boiler-front column centers) is permitted and their width permits placing them so they occupy no more space lengthwise of the boiler room than do the corresponding turbines in the adjacent section. This feature again minimized the floor area and reduced the foundation expense.

Ventilated furnace walls, as well as ventilated ash-pit bottoms, are provided which not only minimize the brick maintenance but preheat the secondary and primary air respectively. The secondary air enters channels in the furnace combustion chamber at the front and below the burners. Its admission is controlled by dampers. Two boilers are equipped with automatic boiler controllers that depend on steam flow or pressure drop to regulate the air admission and coal feed.

Water tubes or screens, as they are called, are provided across the bottom and up the back of the furnace. The lower one cools the molten fly ash so it will not fuse into clinkers and shields the ash-pit contents from radiation which would otherwise fuse the flaky ash collected there. The back-wall screen protects the wall against erosion and prevents clinker formation. Both water-screens are connected to the water and

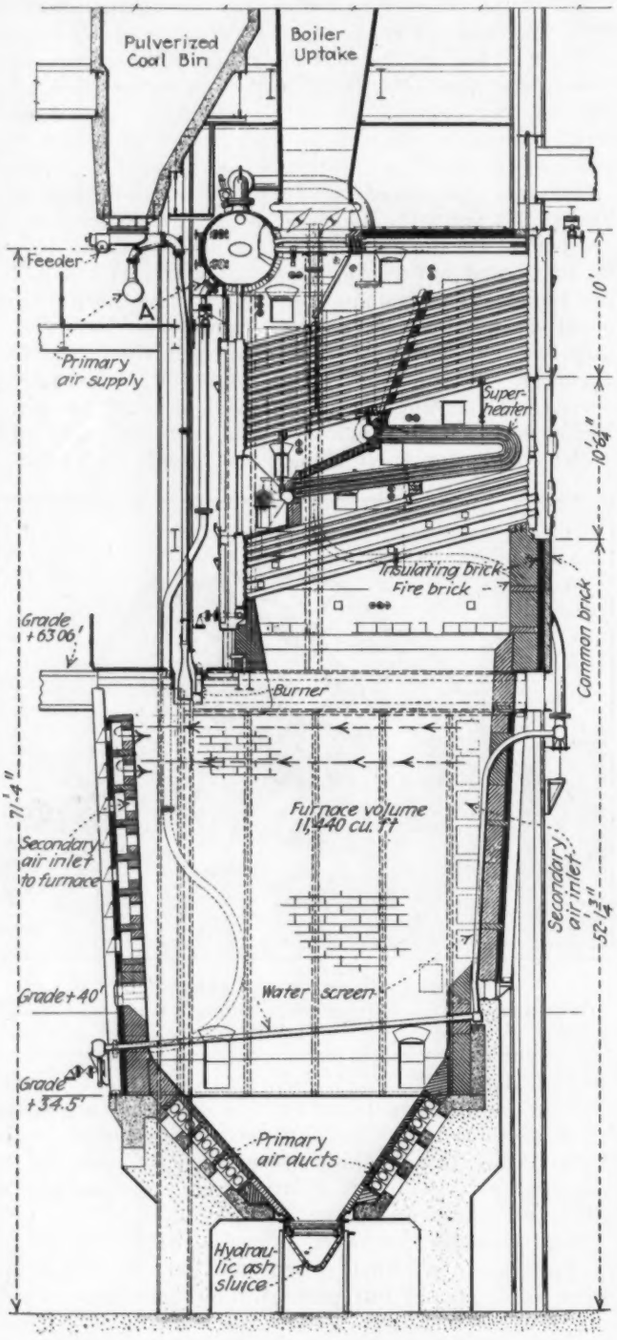
steam space of the boiler cross-drums. These screens exposed to the radiant heat of the furnace add effective heating service to the boiler.

At the bottom of the ash pit is an ashgate that is opened about every twenty-four hours to dump the ash into a hydraulic sluice which conveys it to a sump. From this it is pumped out for filling in ground. Trials show that with increased velocity in the sluice clinkers as large as 6 in. in diameter can be transported, if any of this size ever form. If the sluice ever becomes clogged, it can be cleared by removing the covers.

The boilers are of the cross-drum B. & W. type and have 18,010 sq.ft. of heating surface. While four boilers serve each turbine, three of them will carry the load at 230 per cent rating. They are thirty-eight tubes wide by twenty tubes high, the tubes being arranged in two decks with an interdeck superheater above the lower six rows, which are exposed their full length to radiant energy. The two lower rows of tubes are double-spaced and not staggered, to avoid increasing the velocity of impinging gases carrying molten ash which might adhere to them. This arrangement cools the ash below the slagging temperature before it strikes the remaining tubes. No economizers are used because the coal costs only $2.50 per ton. The feed water is heated largely by bleeding of main turbines. Steam conditions are 300 lb. pressure and 690 deg. F. temperature at the throttle.

Motor-operated valves are used at the header ends of the boiler leads and in the cross-over connection between headers. These permit closing the valves at some remote point in case escaping steam makes it hazardous for an operator to do it by hand, and also because the valves are so large and unwieldy that it would be an arduous task to operate them by hand.

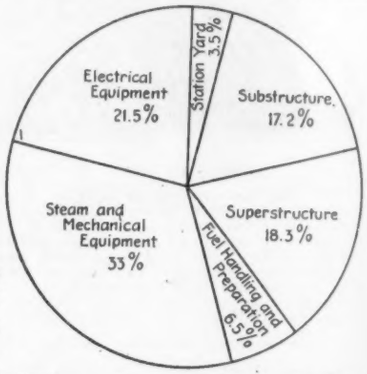
The net cubic feet of boiler plant (including external coal handling and preparation) per rated boiler-horsepower (exclusive of water screen) is 159 for the first section and 125 for the second section.



FEATURES OF FURNACE AND BOILER CONSTRUCTION

Note the height of the boiler settings and the consequent long flame permissible to assure complete combustion. Eighty-five per cent of the air for combustion circulates through channels in the furnace walls, thereby minimizing the brick maintenance and preheating the secondary air. The remaining 15 per cent of air mixed with the coal before admission to the furnace cools the ash-pit lining, thereby helping to prevent fusing of the ash collected there and preheating the secondary air. Formation of slag in the ash pits is prevented chiefly by the water screens at the bottom of the furnace, which cool the incandescent ash below the fusing point before it drops into the ash pit and thus shield the ash pit from radiant heat. This water screen and the one which protects the back wall from flame erosion are connected with the water and steam space in the boiler cross-drum, thereby adding 580 sq.ft. of heating surface without endangering drainage of the boilers in case a water-screen tube bursts. Below the ash-pit gate is a hydraulic sluice with a cast-iron lining. The six lower rows of tubes are exposed to radiant heat from the furnace. Above them is the superheater.

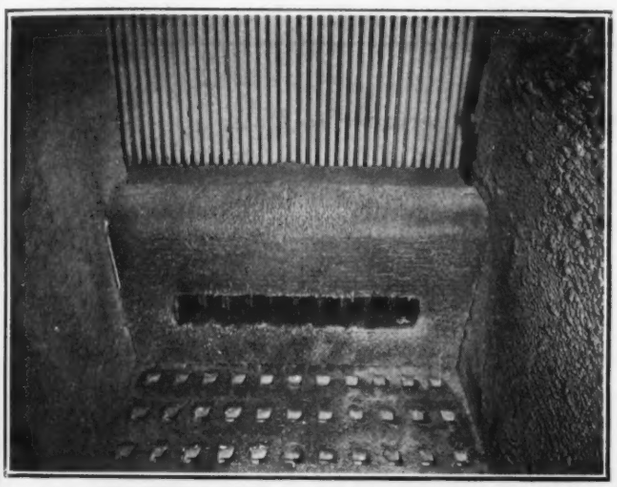
THE CAHOKIA DOLLAR— TOTAL COST FIRST AND SECOND SECTION

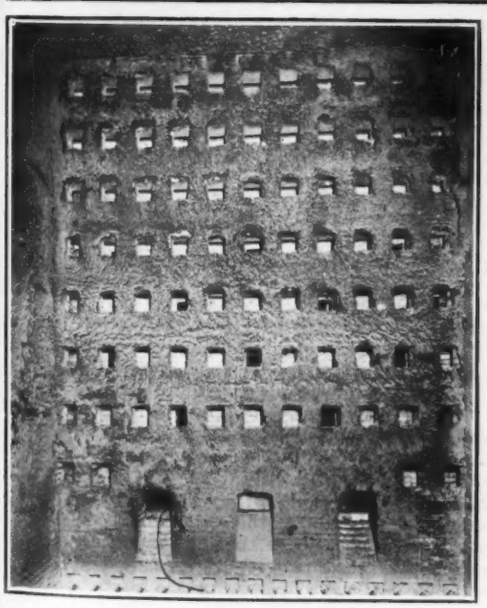


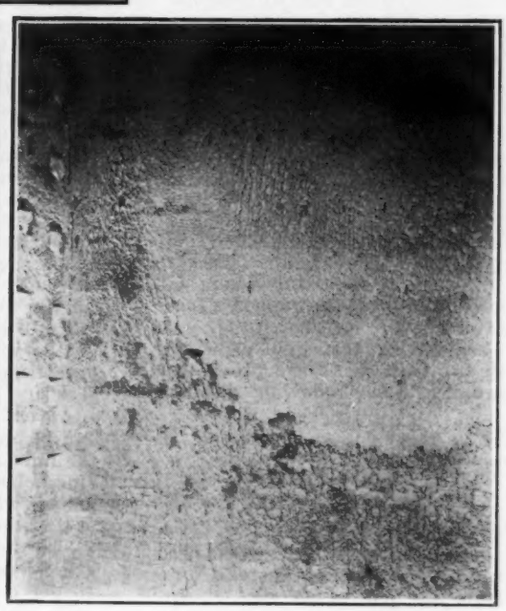
The items included in the various sectors in making up this graphic analysis are given in the following list. The prorated items are distributed proportionately over the various other sectors.

	Per Cent
A—Station Yard	3.5
Levees, railroad tracks, highway, concrete and riprap protection.	
B—Substructure	17.2
Complete below and outside of waterproofing membrane, including:	
Machine foundations.	
Raw coal and ash handling yard structures.	
C—Superstructure	18.3
Complete above and within waterproofing membrane.	
D—Fuel Handling and Preparation	6.5
Track scale.	
Car dump.	
Coal elevating and distributing equipment.	
Crusher and breaker.	
Pulverizing equipment.	
Pulverized coal weighing and transport system.	
(Does not include any driving motors and controls.)	
E—Steam and Mechanical Equipment	33.0
Boilers and superheaters.	
Settings and furnaces.	
Furnace control.	
Draft system.	
Feed water system.	
Condenser system.	
Piping.	
Auxiliary equipment.	
Turbo-generators.	
Ash-handling equipment.	
(Does not include generator end of turbo-generators nor any driving motors and controls for mechanical equipment.)	
F—Electrical Equipment	21.5
Station transformers.	
Switch controls.	
Storage batteries.	
(Includes generator end of turbo-generator and all driving motors and controls.)	
G—Prorated Items.	
Engineering and drafting.	
Office at works.	
Insurance.	
Temporary construction.	
Shrinkage on construction equipment.	
Preliminary operation.	

Very few stations are ccmpelled to use so many types of water as this one. Raw water from the Mississippi is used for condensing, sluicing ashes and fire protection; semi-treated water (mud taken out) is used for cooling compressor jackets, dry-vacuum pumps, fan bearings and oil coolers on the house turbine; treated water (softened) is used for make-up to evaporators; evaporated water and condensate for boiler feed, cooling generator air and turbine and transformer oil cooling. The semi-treated or primary treated water is prepared by the cold process, using calcium hydrate and iron sulphate. The fully treated water is prepared from primary-treated water by the cold process, using barium hydrate. This treatment process constitutes a very important part of the plant operation. Semi-treated water is chlorinated and cooled for drinking.







INTERIOR VIEWS OF ONE OF THE FURNACES

Top, looking up at burner outlets and lower boiler tubes. Note fishtail burners. Left, inside front of combustion chamber, showing secondary air inlets. Right, interior side wall of combustion chamber, showing path of flame as indicated by slight flaky deposit on side wall.

The heat balance in this plant, the electrical features of which will be discussed later, is secured in general by employing motor-driven auxiliaries almost exclusively and using steam bled from the prime movers and house-turbine exhaust for heating the feed water, the load on the house turbines being adjusted to give the desired feed-water temperature. The way in which various heat losses are reclaimed may be thus illustrated: Condensate from the hot well of main condenser goes through the following processes in the order named:

A heat exchanger (cooled by circulating water in summer only), a radiator-type generator air cooler, turbine oil cooler, transformer oil cooler, bleeder heater (receiving steam bled from the main prime mover), evaporator condenser (condensing boiler make-up), an open-heater type deaërator mixing with the exhaust from the house turbine and the two steam auxiliaries (emergency exciter and boiler-feed pump) when in service. From the deaërator the water is pumped to the boilers by the boiler-feed pumps. Gland steam is de-superheated by a small part of the condensate and fed to the bleeder heater, drains from which return to the condenser hot well through a loop seal. A vacuum line from the condenser taps the bleeder heater to prevent its becoming air-bound. Make-up water is distilled in a two-effect evaporator with primary steam supplied by house turbine exhaust after de-superheating.

Turbines which could be bled at three points were available when this plant was designed, and a heat-balance system could have been developed which would require no house turbine. However, it was considered that in the first section at least precautions should be taken in such a large station as this will be to provide means of starting up the station if all tie lines were interrupted. The house-turbine scheme met this requirement and will be sufficient to take care of such an emergency for the ultimate station if one should arise.

Since the next two prime movers will be bled at three points instead of one, no house turbine will be required, and the heat balance arrangement will therefore be entirely different. This change follows from the absence of house turbines in the second and subsequent sections as the two house turbines in the first section are adequate for the ultimate plant.

In the turbine room is a feature which may escape notice unless called to attention. It is the placing of turbines end to end, with the mechanical ends of each pair over a single condenser pit. The end-to-end arrangement makes a narrow turbine room (58 ft. between column centers), and no space is wasted longitudinally in the plant because all equipment in other sections is laid out so that it occupies approximately the same length. A single condenser pit for each pair of turbines was chosen to minimize the investment in the foundation and condenser pit construction, which had to provide for 40 ft. change in river elevation. Putting the condenser and auxiliaries together minimized the space requirement and incidentally enabled cross-connecting the vacuum

pumps so that one will take care of two condensers after starting if necessary.

From the operating standpoint the fact that the floor of the turbine room is at the base of the condenser rather than at the turbine base with condensers in the usual "pit" is worthy of notice.

Two types of turbines are used—one is a seventeen-stage Curtis turbine and the other is a Parsons semi-double-flow unit, both rated at 35,300 kva. and bled at one point. Each unit drives a 13,800-volt, three-phase, 60-cycle, 1,800-r.p.m. generator with a direct-connected exciter. The ventilating air is cooled by a closed system using radiator-type coolers through which the condensate circulates. Water coils are provided in the end bells and provision is made for first admitting CO_2 gas, which serves effectively to suppress any fires which may develop.

Each condenser is a two-pass type and has 53,000 sq.ft. of cooling surface. Two circulating pumps and two condensate pumps serve each unit. Single cylinder, two-stage, single-acting dry-vacuum pumps are used because of their reliability and small power input. The individual circulating-water intakes for each unit are shown in the cross-section of the station.

Other features, particularly the electrical ones, will be discussed in a later article.

The design and construction of the Cahokia station was carried out by McClellan & Junkersfeld, Inc., engineers and constructors, New York and St. Louis, under authorizations of Louis H. Egan, president Union Electric Light & Power Company, St. Louis, and with the collaboration of his technical assistant, H. W. Eales, chief electrical engineer, and of E. H. Tenney, chief engineer of power plants.

An Authorized Statement of Operating Experience to Date Made by the Engineers

THIS station was put into service on October 15, 1923, or about thirteen months after the first pile was driven, because of the urgent demand for additional power.

Since then one turbo-generator has been continuously in commercial service, the other intermittently from November 30 to February 20 and continuously since the latter date.

Seven boilers were put into steaming service on various dates from October 2 to January 10, the eighth boiler on February 15, and the various elements of coal handling and coal preparation as needed in advance of boilers and furnaces.

The total station economy from coal as received on car dump has been as follows:

	B.t.u. per Kw.-Hr. Gross	Net	Maximum Load Kw.	Capacity Factor	Net Output Kw.-Hr.
January (31 days)	17,922	19,310	40,000	30.3	13,503,200
February (29 days)	17,579	18,649	45,000	36.3	15,175,900
March (15 days)	17,339	18,360	45,000	47.0	10,145,400

The foregoing is exclusive of economizers or air preheaters, none having been installed, as the station was designed to burn low-grade coal averaging $2.50 per ton. The station has not yet reached its permanent operating load, as indicated by the maximum load, the capacity factor and output given above.

No official or acceptance tests on principal equipment have so far been made except on the No. 1 turbo-generator, with the following results:

	Water Rate, Pounds per Kw.-Hr., Corrected for 300 Lb. —Gage and 250 Deg. F. Superheat at Throttle—		
Load, Kw.	Vacuum ½ In. Abs.	Vacuum ¾ In. Abs.	Vacuum 1 In. Abs.
30,000	9.42	9.45	9.56
23,000	9.57	9.64	9.80
15,000	9.97	10.20	10.41
10,000	10.54	10.90	11.30

The temperature of the flue gases to driers has been varied from 200 deg. to 380 deg. F. for trial and observation, but the average has been increased from time to time and was 300 deg. F. during the first fifteen days of March. The coal used is of a character that catches fire occasionally in ordinary raw-coal bunkers. Since the first drier was put into service coal has caught fire twice in drier No. 4 to an extent requiring repairs, the first time at a cost of about $1,400 and the second time at about $100. There were no other fires that required repairs. These two fires were the result of shutting down the driers before all of the coal had passed through them. By making it a practice to shut down the driers sufficiently in advance of the mills to prevent lodgment of warm coal in drier, any subsequent fire from spontaneous combustion is thus prevented. There have been twelve smaller so-called fires requiring no repairs and extinguished readily with steam permanently piped with relief for that purpose to the driers, most of them occurring when the driers were out of service and full of warm coal. Such other hot spots as were found occasionally in driers or hoppers below were not sufficient to warrant turning on the steam. Tests have been and are still being conducted at different flue-gas temperatures to determine the particular gas temperatures for coals of different moisture content which will produce the best results. The maximum gas temperatures entering the driers are sufficiently lower to insure no fires directly from hot gases. All fires that have occurred were due to spontaneous combustion of warm coal left in driers or hoppers subject to air infiltration.

The installation of gates between bunkers and driers, the replacement of butterfly dampers with sliding gas-tight dampers and some improvements inside the driers and ducts will make it possible to reduce greatly the number of fires and more quickly to isolate and extinguish fires.

There have been six fires in about six months in the eight pulverized-coal bins, due to spontaneous combustion at times of low barometric pressure. These fires broke out directly under the open vent pipes. They were easily put out by closing the bins and allowing the CO_2 gas generated in the bin to smother the fire. The vent pipes have since been equipped with light-weight check valves which relieve the bin of excess pressure and at the same time prevent the entrance of air.

The station records indicate that furnace operation has been adjusted to give 15 per cent to 16 per cent CO_2 without slagging in the furnace with exit gas temperature of 450 deg., leaving the boiler at 190 per cent rating. No repairs have been found necessary on the boiler furnaces or water screen, and the last inspections indicate no distress in any part.

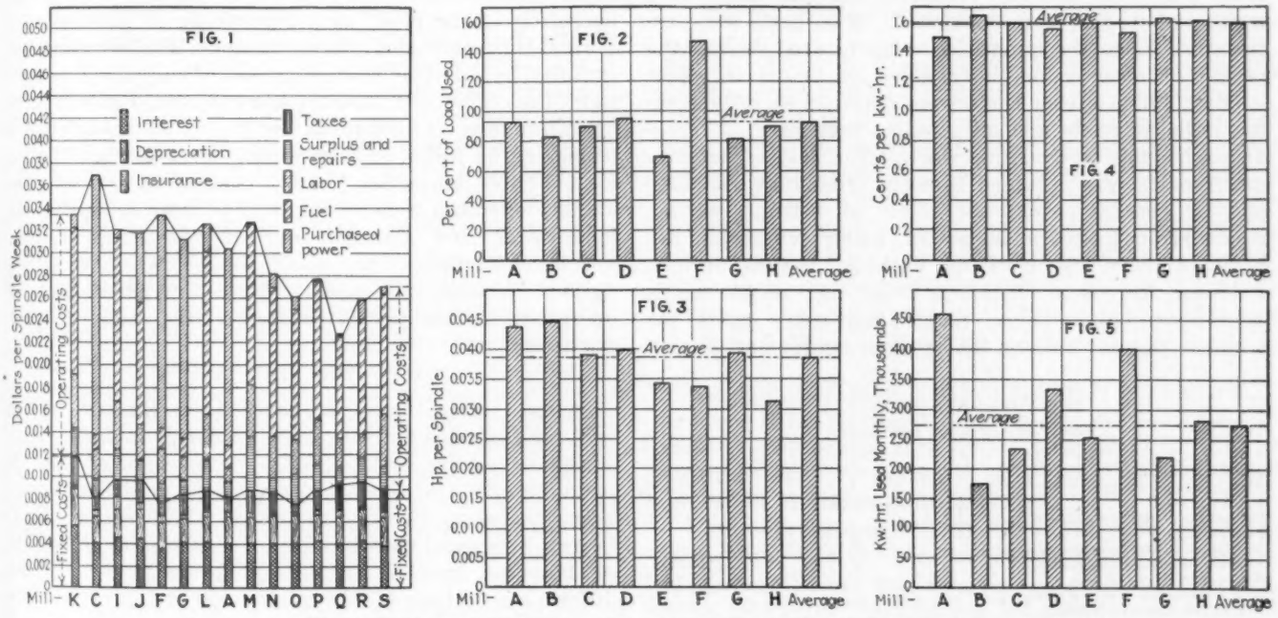
After about five months of preliminary testing, operating and research, designs have been approved and contracts placed for Unit No. 3 fuel preparation, including driers, transport and combustion equipment to duplicate substantially that on units Nos. 1 and 2, on which the experience obtained has been embodied as stated above.

Power Costs in Cotton Mills

Survey of Conditions in Twenty Mills—Relative Values of All Cost Elements —Purchased Versus Made Power and Combinations —Analysis of Load Conditions

IN THE last few years, owing to the rapid increase in the use of purchased electric power in cotton mills, a great deal of valuable information on power usage has become available. A graphic presentation of some of these data should be of sufficient interest and value to warrant its appearance in the columns of the ELECTRICAL WORLD.

A group of about twenty cotton mills has been selected for the purposes of comparison, ranging from mills of 25,000 spindles to mills of 140,000 spindles and from mills which buy no power up to those which purchase energy for all their needs. These mills will be designated by the letters of the alphabet for more ready reference.



COMPARISON OF OPERATING DATA OF TWENTY LARGE COTTON MILLS

Fig. 1—Comparison of fixed and operating costs on fifteen different cotton mills. Mills are arranged by spindle capacity in ascending order.

Fig. 2—Percentage of connected load used on basis of 200 hours use per month.

Fig. 3—Horsepower per spindle for eight mills.

Fig. 4—Cost per kilowatt-hour in eight cotton mills purchasing energy.

Fig. 5—Monthly consumption of energy by eight mills.

As many of the figures appearing in the tables are based on the unit of the "spindle-week," it will probably be well to define this unit and state why it was chosen instead of some other standard of comparison.

The "spindle-week," or the output of one ring-spinning spindle in a normal working week of forty-eight hours, having been taken as the unit, the product of the number of spindles in the mill by fifty weeks of forty-eight hours each becomes the divisor in obtaining many of the units of yearly cost shown here. It is not an absolutely perfect unit of measurement, but was chosen as the best one for use in this particular case, where mills diversified in size and type of product were concerned. It was out of the question to use such units as yards or pounds of goods produced, or value of same, since some of the mills recorded produce less than 100 yards of cloth per loom-week on some of their styles, while others, using no more power but with similar looms on different styles, turn out ten times this yardage. On yarns there might be a variance of from 0.5 lb. to more than 4 lb. in the amount produced weekly per spindle, values of output, of course, varying quite as widely. In the case of many of the mills which run overtime on full or partial production, allowances to bring figures back to the basis of forty-eight hours per week have had to be made.

As regards other units of value, etc., used here, they were mostly derived from very careful appraisals by consulting engineers, these appraisals being originally used in making up tax returns. The item of taxes itself was prorated from the total tax paid according to the percentage of plant value represented by the power department, the same method being used in the case of fire insurance, which was then combined with the items of boiler, engine and flywheel insurance. The fixed charges include interest, insurance, depreciation and taxes, interest being placed at 6 per cent of the value of all land, buildings, machinery, etc., entering into the provision of light, heat, and power. Depreciation charges were taken as 2 per cent of value of power-plant buildings and 4 per cent of the machinery and equipment used in the power plant. Orginal costs were used to figure fixed charges from, rather than present-day replacement costs, since in the case of the old

TABLE I—GENERAL MILL DATA

Mill	Spindles	Horsepower Installed	Type of Drive	Per Cent of Power Purchased	Product	Fuel Used	Remarks
A	80,300	3,640	Electric (group)	100	Print cloth	Oil	
B	29,500	1,450	Electric (mixed)	100	Fine goods	Coal	
C	44,000	1,820	Electric (mixed)	100	Print cloth	Coal	
D	60,500	2,410	Electric (mixed)	100	Print cloth	Coal	
E	70,350	2,415	Electric (mixed)	100	Print cloth	Coal	Fuel used for heating and process only
F	53,600	1,810	Electric (group)	100	Fine goods	Coal	
G	56,300	2,215	Electric (mixed)	100	Print cloth	Coal	
H	66,770	2,080	Electric (mixed)	100	Fine goods	Coal	
I	44,000	1,200	Steam (mech.)	11	Print cloth	Oil	
J	52,000	1,600	Steam, 1,145 hp. Electric, 455 hp.	28	Fine goods	Oil	All weaving on purchased electric power
K	28,400	790	Steam (mech.)	5	Print cloth	Coal	.....
L	56,400	1,600	Steam (mech.)	16	Print cloth	Coal	Individual motors on some spinning frames
M	82,100	2,850	Steam (mech.)	1	Print cloth	Coal	.....
N	86,200	2,250	Steam (mech.)	5	Print cloth	Coal	.....
O	91,470	2,700	Steam (mech.)	11	Print cloth	Coal	.....
P	123,000	4,200	Steam (mech.)	0	Prnit cloth	Coal	.....
Q	130,470	3,500	Steam (mech.)	3	Fine goods	Coal	.....
R	133,750	3,000	Steam (mech. and elec.)	16	Fine goods	Oil	Low-pressure turbine in combination with engine
S	139,180	4,400	Steam (mech.)	15	Print cloth	Coal	.....

steam-engine-driven mills the existing equipment would, of course, never be duplicated in case of actual physical replacement.

The cost of purchased power and light were taken from the bills actually rendered for the term over which the studies were conducted. Fuel costs were ascertained from the quantities actually used during the period of observation, but valued at prices in effect in May, 1922. Labor costs were obtained directly from the mills' payrolls and adjusted to take care of irregular schedules or overtime work. The cost of supplies and repairs was obtained directly from bills rendered and in general covers the items of belting, wiring, steam piping, electric bulbs, oil, boiler compound, fire brick and clay, pipe covering, packing, gaskets, pulleys, shafting, fire tools, oilers, oil drips, belt hooks, motor drip pans, boiler plugs, repair and spare parts for engines, pumps, boilers, boiler-room equipment, steam-piping repairs, rewinding motors, spare bearings, etc.

TABLE II—DATA ON MILL C

(Two hundred hours per month)

Number of spindles	44,000
Horsepower connected	1,820
Type of drive	Electric (individual and group)
Percentage of power purchased	100
Product	Print cloth
Fuel (heating and process steam only)	Coal
Cost of power per spindle-week	$0.037
Hp. connected per spindle	0.0390
Cost per kilowatt-hour for power	$0.0162
Kilowatt-hours used monthly	230,000
Kilowatt-hours used per spindle	5.2
Cost of power per spindle month	$0.0845
Percentage of connected load used	84

TABLE III—CONSUMPTION-DATA ON MILL C FOR YEAR 1922

Month	Kw.-Hr. Used	Net Bill	Cost per Kw.-Hr.	Cost per Spindle-Month
January	216,000	$3,543	$0.01641	$0.0805
February	219,000	3,587	0.01639	0.0815
March	265,000	4,127	0.01558	0.0938
April	227,000	3,455	0.01522	0.0785
May	243,000	3,719	0.01530	0.0845
June	246,000	3,797	0.01544	0.0863
July	223,000	3,557	0.01595	0.0808
August	253,000	4,139	0.01636	0.0941
September	218,000	3,512	0.01611	0.0797
October	214,000	3,514	0.01642	0.0798
November	239,000	3,899	0.01631	0.0885
December	232,000	3,812	0.01643	0.0866
Totals	2,795,000	$44,661	.....	.....
Average	232,917	$3,722	$0.01598	$0.0846

Mention has been made before of allowances and corrections to take care of curtailment in production or of overtime operation. The abnormal schedules resulting from these causes were allowed for by expressing the operation of the plant as a percentage of full-capacity normal-time operation, the percentage thus obtained being used as a divisor in finding cost of purchased power, light, fuel, labor and supplies and repairs. Full-capacity operation was considered as the use of all spindles and looms in the mill for fifty weeks of forty-eight hours each (2,400 hours per year). Actual figures of machinery operated were in this way reduced to equivalent loom-weeks and spindle-weeks of forty-eight hours, and a comparison of the totals thus obtained with the figures representing capacity gave the percentage of operation for the period covered in the study of that particular mill.

DATA FOR YEAR 1921

In most cases the period covered for the data given was for the calendar year 1921, although in some cases somewhat earlier or later dates were employed, and in one case only six months' figures were used, variations being necessary to avoid distortion of facts due to abnormal or special causes, such as a change from coal to oil burning, unusual curtailment periods, etc. These differences in time of observation do not affect results appreciably, especially since in the case of fuel and labor direct adjustments were possible to correct any error.

There are, however, some unavoidable factors which do in a measure affect the accuracy of the figures as herein given. For instance, the average size of the mills purchasing all their power happens to be considerably less than that of the steam-driven mills as studied in this article, which, of course, reacts to the disadvantage of the smaller mills and to the advantage of the steam-driven mills. These are further favored by the fact that one of the mills obtains a considerable portion of its power from waterwheels. Moreover, the use of fuel oil is in favor of the steam-driven group of

TABLE IV—ITEMS OF POWER COSTS IN FIFTEEN COTTON MILLS EXPRESSED IN PERCENTAGE OF TOTAL

Power Cost Items	K	C	I	J	F	G	L	A	M	N	O	P	Q	R	S
Interest	16.8	10.8	14.0	14.2	10.5	12.8	12.6	13.2	12.2	14.3	15.3	15.2	17.6	16.7	14.5
Depreciation	9.5	6.5	8.1	8.2	6.6	7.4	6.8	7.9	7.4	8.5	9.2	8.3	10.1	10.4	8.5
Insurance	0.6	1.6	3.1	1.3	1.8	0.3	1.2	0.9	1.0	0.4	1.1	1.4	3.1	0.4	2.2
Taxes	8.4	3.0	5.0	6.6	3.9	6.4	6.1	4.3	6.3	7.1	3.0	6.5	10.1	8.9	7.1
Supplies and repairs	7.8	4.3	8.8	5.6	5.1	3.9	8.7	4.6	14.7	4.6	10.0	8.7	7.1	8.9	8.2
Labor	14.4	7.3	13.8	10.1	9.6	7.0	12.6	4.3	14.1	13.5	12.3	14.5	11.5	8.5	17.0
Fuel	38.9	3.8	45.0	34.4	5.4	5.2	44.3	6.6	44.0	47.0	44.5	44.7	40.1	39.2	40.0
Purchased power	3.6	62.7	2.2	19.6	57.1	57.0	7.7	58.2	0.3	4.6	4.6	0.7	0.4	7.0	2.5

mills, and they are further helped out because one of their number has exceptionally low taxes as it is located just outside the city limits. On the other hand, some of the steam-operated mills have power plants of such ancient design that their efficiency is not so good as it should be. This militates in favor of the mills buying power, except that it is somewhat offset by the fact that were more efficient plants installed, fixed charges would, of course, be correspondingly increased.

Since these figures were obtained a drop of about 5 per cent in the cost of purchased electric power has taken place, which would act greatly in favor of the mills buying and which should be allowed for in considering the comparison of these plants with those making all their own energy.

The general data covering the mills considered are given in Table I. This table is reproduced here simply to bring out the point that mills of all sizes and types of drive and product are included in the study, and also to enable the reader to pick out a mill of about the same size and type as the one he is particularly interested in and follow it through other tables of data by its distinguishing letter.

A comparison of power-cost items of fifteen different mills is given in Fig 1, arranged by spindle capacity in ascending order. As shown in the legend, fixed costs include interest, depreciation, insurance and taxes, and operating costs are labor, fuel, supplies, repairs and purchased power. It will be noted, as would be expected, that on the whole the unit of cost decreases as the size of the mill increases. Mill Q shows exceptionally low operating costs, due, so far as appears, to very economical operation and high fuel economy.

A group of eight mills all operated entirely by purchased power is shown in Fig. 2, and compared on the basis of the percentage of their connected load actually used, on an assumed month of 200 hours. Mill F shows nearly 150 per cent of use of its load, owing to the fact that about half the plant is operated all night long, and looms, which are all of the automatic type, are always allowed to run after the operatives leave at noon and at night till most of them have "knocked off." From this table the average mill is shown as using 85 per cent of its connected load.

The same group of mills is represented in Fig. 3, which gives the horsepower connected per spindle. In this case the average mill shows 0.0385 hp. per spindle for connected motor load. In Fig. 4 is given the cost per kilowatt-hour in these same mills. It will be noted that the variation in cost is very slight.

The monthly consumption in kilowatt-hours for these eight mills is shown in Fig. 5, variation being greater in this item than in any other, high consumption, however, being due apparently more to long hours of running than to the size of the mill, as will appear if Table I and Fig. 2 are referred to.

The kilowatt-hours consumed per spindle is given in

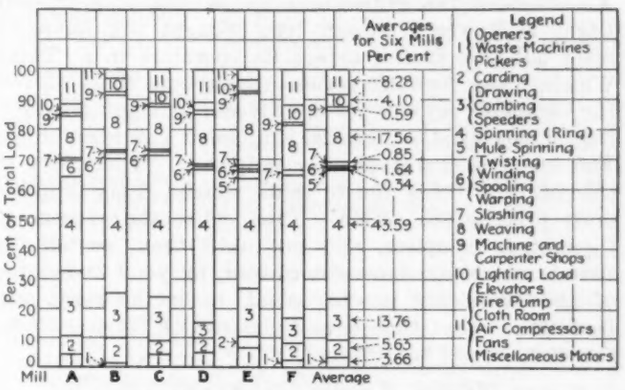


FIG. 9—DISTRIBUTION OF LOAD IN SIX COTTON MILLS

Fig. 6, while Fig. 7 represents the cost of energy per spindle month for the eight mills.

In Figs. 2 to 7 inclusive, with the same group of eight mills using purchased power, the mill which comes nearest to the average in all respects is Mill C, and in rough estimating the data on Mill C might be used with safety. It might be well to collect these figures on Mill C in one place for ready reference, as is done in Table II, while the consumption data on Mill C for each month of 1922 are shown in Table III. The fluctuations of load in Mill C are shown more clearly in curve in Fig. 8.

The distribution of load requirements in cotton mills as regards the machinery employed in the actual manufacture of goods is represented graphically in Fig. 9, six mills using purchased electric power exclusively being taken to arrive at an average.

Table IV gives the items of power costs in fifteen mills with both electric and steam drive, in terms of percentage of the whole.

By correcting the cost per kilowatt-hour to coincide with the large users' power rate in any particular locality, and by choosing the size and type of mill nearest the one under construction, fairly accurate figures for rough estimation on almost any cotton mill should with the preceding data be possible.

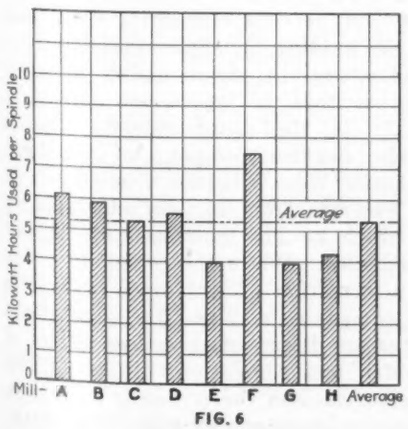


FIG. 6

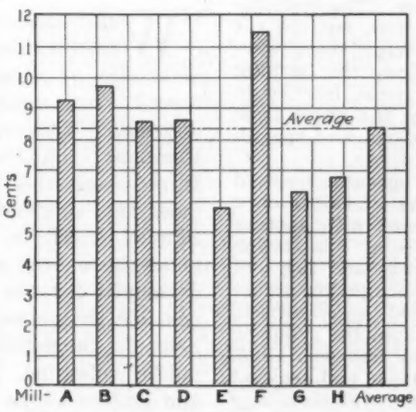


FIG. 7

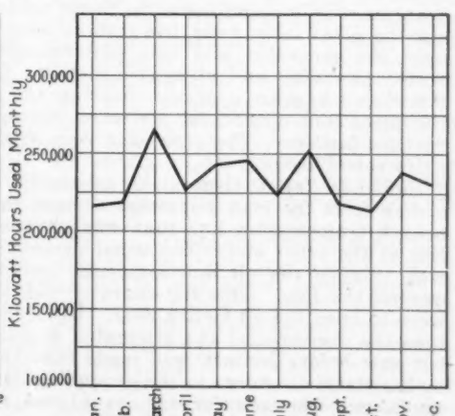


FIG. 8

FIG. 6—KILOWATT-HOURS USED PER SPINDLE IN EIGHT MILLS. FIG. 7—COST OF ENERGY PER SPINDLE-MONTH FOR EIGHT MILLS. FIG. 8—CONSUMPTION OF TYPICAL MILL PER MONTH

Experiences Prevent Accidents

Mid-Western Company Passes on Instances of Actual Switching Mistakes in Order to Place Their Operating Men on Guard

IN ITS program to minimize accidents caused by carelessness or thoughtlessness the Wisconsin-Minnesota Light & Power Company has brought the following brief but true stories before its operators in a "Think Which, Then Switch" series. Regarding these stories the company says to its employees: "Their lesson is that if you handle electrical equipment you must think. You are the brains of the equipment. Your part of the job is to think and to think which. This thinking must precede the action. Then, when the process of thought is complete, and not until then, switch the switch which you have determined, by your knowledge of and experience in your plant, to be the right one. Had these men stopped to 'think which, then switch,' the story would be different."

"THINK WHICH, THEN SWITCH"

Opened Wrong Disconnect.—An operator in a two-unit hydro-electric plant took his No. 1 generator off the line, then, for some reason that will never be known, opened one blade of the air-break disconnects on the No. 2 machine, which was still on the line. The arc from the opening switch went across the blades and bus work and, backed by the energy of the super-power system, held on. The bus work, oil switches, and other equipment were destroyed and the operator was fatally burned.

Smoke-Bewildered Operator.—A feeder-voltage regulator started to smoke. The operator became excited and opened the blade disconnecting switches on the regulator while the regulator was still in circuit. Blades and panel were destroyed and service seriously interrupted. An expensive rewiring job was necessary.

Closed Wrong Breaker.—A substation operator started a rotary converter and got it on the alternating-current line. He then went to the direct-current board and closed the breaker and knife switch on another machine that was standing still. This machine started to revolve, accelerated very rapidly, broke the speed-limit switch, ran away and threw nearly all the coils out of the armature before any one realized that an error had been made. Nobody was hurt, but the machine had to be entirely rewound.

Closed Horn-Gap Instead of Transfer Switch.—An electrical repair man and his helper were repairing a lightning arrester, protected by the wide-open horn gaps. The repairman finished adjusting the transfer switch and called to his helper to "close her up." The helper unlocked and closed the horn gaps, connecting the arrester to the 40,000-volt line, when he should have closed the transfer switch. The repair man was fatally burned.

Forgot to Disconnect Generator.—A hydraulic generator broke down, caught fire from the rush of energy from the transmission line and began to throw solder. The operator cut the plant loose from the transmission line, but did not open the generator and field switches, though these were easily accessible and at a safe distance from the burning machine. Another operator, hearing the noise, hurried to the plant and opened the switches, saving the plant from further damage. The generator was wrecked, and the repairs cost $10,000.

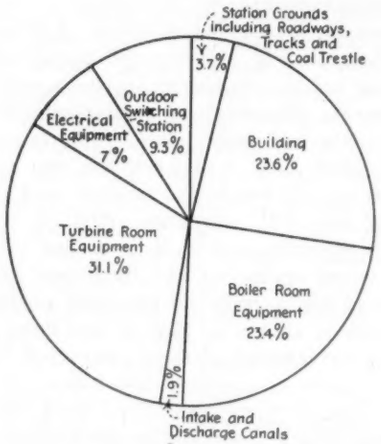
Failed to Repeat Orders.—A substation operator received orders from the load dispatcher to open the oil switch on a branch transmission line that was paralleled with another line at the other end. The usual procedure at this station was to open the oil and air-break switches and tag and ground the line. This the operator did, though his orders were to open the oil switch only. He opened the oil switch, then the disconnects, and attempted to put on the grounds, but saw before contact was made that the line was alive, by the static discharge to the grounding device, and dropped the latter. The operator was not injured, nor was there any damage done to equipment, but it was a very close call.

Grounded "Live" Line.—An operator who was directing switching on a branch line instructed another operator to ground the transmission line. The first operator then remembered that he had not opened the transmission-line switch. It was too late to call the other man back, so he hurried to the switch, which was outdoors, to open the line, but it was too late. The grounds were thrown on the energized line, and service was seriously interrupted in several important towns. The disturbance was felt in more than a hundred communities.

Depended on Horn-Gap Switch.—An electrical repair man had been working on aluminum-cell lightning arresters with the transmission line dead. He released the line and after it was energized found that he had overlooked a necessary adjustment. He opened the horn gaps, then loosened a nut, and the horn turned in its support and fell over into contact with the energized side of the gap, allowing 72,000 volts to pass through his body to the ground framework. He was very badly burned and shocked and though resuscitated by the prone-pressure method, died later from the effect of the burns.

How the Devon Costs Were Divided

WHILE actual figures on the cost of the Devon station, which was fully described in the March 22 issue of the ELECTRICAL WORLD, are not available, the Connecticut Light & Power Company has furnished to



the ELECTRICAL WORLD the accompanying "dollar diagram," which indicates the relative expenditures under the headings indicated on the diagram.

A Creed of Good Management

Principles of Public Utility Conduct—Compilation of Policies Expounded Publicly at Different Times by Samuel Insull

"WHY DON'T you get out something that puts into words the guiding principles that are characteristic of 'Insull policy' in public utility management?" is a question that is typical of a variety addressed frequently to the Commonwealth Edison Company, the Public Service Company of Northern Illinois and the Middle West Utilities Company. To meet this demand excerpts from various addresses by Samuel Insull in which he has expressed a company policy have been compiled. While the compilation was developed for the information of employees only, it is possible that other companies may find the suggestions helpful. Such things are discussed as various angles of public relations, rates and regulation, utility officials and employees as citizens, and the economic soundness of concentrated power production and wide distribution.

Some excerpts are reproduced on the following page for the benefit of companies who care to make use of them.

Most Important Thing in Management

The question of publicity and public relationship is of more consequence than all others put together because it involves, above everything else, the safety of our capital, the development of our business and the permanency of our business. Our first duty is to see to it that everybody in our organizations, from the man at the top to the girl at the cash window or the boy who delivers bills, is so educated in the fundamentals of our business that he will carry home to all of our customers this primary fact—that recognition of the duty we owe to the public stands in our minds alongside of our duty to the owners of the properties we manage.

Harmonize the Rights of Stockholder and Public

Our first duty and our first interest is to square the rights of the public with those of the stockholders. Our income, our earning capacity, is dependent, primarily, in my judgment, upon public good will; and we cannot get that unless we convince the public by word and deed that we are treating it honestly and giving it a square deal. If the rights of the public are properly taken care of in producing lower costs and steadily improving service, the rights of the stockholders will take care of themselves.

Put all Cards on Table

Take the public into your confidence, not as a favor to it, but as its right. We are getting our income from the communities; we are depending on them for success, and, therefore, the wise thing for us to do, from the point of view of the narrowest self-interest, is to take them into our confidence and treat them with absolute fairness. It matters not how much capital you may have, how fair the rates may be, how favorable may be the conditions of service, if you haven't behind you a sympathetic public opinion, you are bound to fail.

Courtesy and Service

Courtesy to the public and the best possible service constitute the fundamental cornerstone of our policy. It must necessarily be the fundamental cornerstone of the policy of every public service utility. We should aim at nothing but the best, and we should aim at administering that service in such a way as to conform, so far as we can, not only to the good judgment of the public and to its proper desires, but also to its peculiarities and idiosyncrasies. This is what is involved in the question of courtesy to the public.

A Creed of Publicity

I am a great believer in publicity. I believe it is our duty to the properties we manage, to the stockholders who own them and to the communities we serve that we should enlighten these communities on the situation. I believe in doing this, not in any "gumshoe" way, but openly and boldly. I believe in presenting the facts to the employees, whose interest is just as vital as that of the managers; to the citizens of the state who are owners of the properties, and to every customer of a gas company, an electric light and power company or a street railway.

Rates Subject to Economic Law

There is only one possible way to develop this business [the public utility business generally, and especially the electric light and power business] to great permanent success, and that is on a basis of low cost of production, a minimum cost of distribution and a minimum selling price to the community.

The real governor of utility service rates is economic law. Adjustment to that is automatic and goes on relentlessly. If the prices of labor, material and money go up, rates will go up or the service will stop. If the prices of labor, material and money go down, rates will go down, and nothing can prevent it. That has been the experience of the ages whenever regulation of the prices of any commodities has been attempted, and it applies as much to energy in the shape of electricity or transportation or gas as it does to more tangible commodities.

Fair Dealing Must Be Reciprocal

The public cannot expect us to be in a position to maintain good service unless it is willing to treat us fairly. Whether we are dealing with the public as individuals or dealing with the people collectively as a community, we have a right, in return for the service that we render, to be treated fairly by the public.

Faith in Public

I have an abiding faith in the honesty and good judgment of our citizenship. Once it comes to understand the economic facts of the public utility situation, I do not believe it will permit economic progress to be blocked by the pandering of politicians to local prejudice. The business sense of a community in the long run determines the attitude of that community toward economic questions.

Way to Get Lower Rates

The way to get lower rates and better service from the public utilities is to let them develop in harmony with industrial necessities and economic law. That means encouraging concentrated production and still wider distribution.

Expectation that rates for utility service can be reduced merely by reversion to local regulation is a delusion, fed entirely upon misinformation and misrepresentation. Under regulation by state commission, public utility companies are already under the strictest possible control. If, by accident, rates should be fixed that are higher than they ought to be, the commission has ample power to reduce them. What city council can equip itself, except at staggering expense, to do all this for just one community?

Utility rates, no matter by whom fixed—by a state commission or a city council—must be sufficient to provide for operating costs and a reasonable return to the owners of the utility. That is the decision of the highest courts, and city councils cannot reverse it. How, then, are city councils to fix rates lower than a state commission has fixed, unless they intend to act arbitrarily, without investigation or information, and fix rates which cannot be sustained?

Home Rule Self-Condemned

Efforts to cripple the public utilities under cover of the seductive term "home rule" are self-condemned; the arguments most employed are of no merit and are of questionable sincerity. We are told the utilities ought to be regulated by local municipal authority, instead of by a body of state-wide authority, because under state regulation many of them have been permitted to advance their rates. Who hasn't advanced his selling prices since the world war began in 1914? Who hasn't had to do it or "go broke"? As a matter of fact, utility service rates have advanced less than any other class of prices, although the utility companies have had to pay two and three times pre-war prices for their labor and materials. Today public utility service is relatively cheaper than anything else we buy, whether for our business, our amusement, our tables or our backs.

Utility Officials and Employees as Citizens

Public utility men have opportunities for community usefulness and for unselfish service that few men engaged in private business have. They are more or less semi-public servants; they should perform their functions with a recognition of their duty to the state. We should so conduct our affairs with the community as to give us the advantage of a reputation for absolutely fair and impartial dealing. We should preach the same doctrine to our subordinates and insist upon the same policy being carried out in their dealings with the public.

I am a firm believer in responding to the responsibilities of citizenship. That can be done only by men and women taking part in the community life of the towns and villages in which they live and assisting in every civic enterprise for the good of the community.

Economic Soundness of Concentrated Production and Wide Distribution

It is not necessary—it is an economic blunder—to have a generating station in every small community, irrespective of what other small communities are adjacent to it. Where the massing of energy takes place in a number of communities more or less close to one another, so that they can be joined up by a system of high-tension distribution, those combinations are following true economic laws, and if properly financed are bound to succeed.

Prior to the war a man like myself, engaged in trying to create a state-wide distribution system, was looked upon more or less as a monopolist, as representing "the interests" and as one who ought to be looked after with a sharp stick. During the war, when it was necessary to save every dollar of capital and material and labor, Dr. Garfield, the fuel administrator, just on one short page, gave orders to connect up various electric systems, to shut down uneconomical power stations, and where there were two plants, one economical and the other uneconomical, to shut down one if the other could produce the necessary amount.

For years the newspapers had been full of objections to that kind of thing, and the demagogues who wanted to catch votes by attacking corporation interests would hold men like myself up to the public as persons to be avoided. But when the pinch of war came what we had for years been advocating was indorsed in a few minutes.

Interconnection Alias "Superpower"

I look forward with confidence to the time when the lines in the Central West [covering Minnesota, Wisconsin and Illinois], stretching across to Louisville and again across the State of Kentucky, will meet other lines coming from the eastward across the Allegheny Mountains, and when every available particle of power within the area indicated will be employed for the common purpose of producing energy at the least possible cost, and when every home and every factory and every transportation line will obtain its energy from one common source, for the simple reason that that will be the cheapest way to produce it and distribute it.

We are now getting well into the third stage of public utility development, which is marked by still further concentration in production and still wider distribution. Public utility companies must, more and more, cross state boundaries and become interstate in their operations, as they once crossed municipal boundaries, if their full measure of usefulness to commerce and industry and to organized society is to be realized.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Larger Appropriations Justified for Industrial Heating Business

To the Editors of the ELECTRICAL WORLD:

Recently a representative of a large Western electric lighting company stated that an electric range campaign conducted by that company resulted in the installation of 2,000 ranges in local residences at a total cost of $75,000. From this it will be noted that the cost of installing each range was $37.50. The average yearly revenue is $39. On this basis, $600 could be spent by the central station to secure the installation of a 25-kw. industrial electric furnace.

These figures are quite illuminating and seem to bear out the opinion held by many that the central-station companies have been spending a tremendous amount to obtain small-residence business and yet are hesitating to spend much of anything at all to secure industrial heating business.

V. M. F. TALLMAN,
Power Engineer and Chairman Power Bureau, Commercial National Section, N. E. L. A.
Charles H. Tenney & Company,
Boston, Mass.

Influence of Wave Shape on Test Voltages Measured by Voltmeter

To the Editors of the ELECTRICAL WORLD:

In the February 23 issue of the ELECTRICAL WORLD, page 385, you published a short article on "Importance of Sine Wave for Test Voltage." I am quite interested in this subject of wave shape and its effect in producing discrepancies in test voltages measured by voltmeter.

Commercial alternators and even some laboratory sine-wave machines will in certain test set-ups produce distorted waves. Operating companies frequently have occasion to high-pot apparatus or take flashover of insulators or the puncture value of cable dielectric or perhaps spark potential of lightning arresters, and generally almost any available apparatus of suitable rating for the test is used and voltages are read by voltmeter through ratio of testing transformer or separate pot transformer. However carefully the test set-up is arranged and the sequence of tests carried out, such tests cannot always be credited as accurate until the ratio of the effective value to crest value of the voltage wave is known. While the most accurate analysis of wave form is given by the oscillograph, in high-voltage testing a more simple analysis to show the crest factor of the voltage wave can be made by using the sphere gap.

For instance, suppose an insulator being tested flashes over at 100 kv. as indicated by voltmeter and transformer ratio. A sphere gap may be connected in parallel with the insulator and carefully adjusted to something less than the insulator flashover—say 90 kv. setting—the spacing for this setting being taken from a standard calibration curve made with sine wave. The voltage may then be raised slowly and the voltmeter read at the instant the sphere gap sparks over. If several readings indicate the average sparkover voltage to be, say, 70 kv., then the wave is not sinusoidal and the crest factor is ninety-seventieths times 1.41 instead of 1.41, which was assumed before the test. Therefore, the voltage indicated by the voltmeter must be multiplied by the correction factor of ninety-seventieths, or about 1.29, to make it equivalent to a sine-wave test, and thus the flashover voltage first read of 100 kv. is in reality 129 kv. This correction factor, however, may vary with different values of field excitation on the alternator and may also vary with the nature of the test piece.

The writer at one time used a commercial alternator as a source of power for a 150-kv. testing transformer. A large number of insulators were to be tested, and as an expedient the test set-up included ten insulators in parallel. This, of course, represented quite a bit of electrostatic capitance, effecting some little charging current. The alternator wave form without insulators connected was analyzed by oscillograph and also by sphere gap and a correction factor of 1.22 found necessary. This means that in the natural alternator wave the crest value was 1.72 times the effective value. However, with the insulators connected to the testing transformer the wave distortion was much greater, and the correction factor varied from 1.23 at 30 per cent of insulator flashover voltage to 1.4 at 90 per cent of insulator flashover voltage. As the voltage increased on the insulators, the charging current, of course, increased and caused increase in the voltage-wave distortion. The correction factor of 1.4 indicates a crest factor of 1.41 times 1.4, or 1.97—that is, the crest of the voltage wave was 1.97 times the effective value for the adjustment of 90 per cent flashover of the ten insulators in parallel.

It was concluded that, even though crest values are known for a given machine, it is desirable to take a sphere-gap check of the crest factor with the test piece connected in parallel with the sphere gap. The A. I. E. E. Standards, Rules 2358, 2359, 2360, 2361, 2362, 2363, 2366, 2369 and 2370, should be referred to in studying this subject.

H. M. TOWNE,
Lightning Arrester Engineering Department.
General Electric Company,
Schenectady, N. Y.

Disagrees with Mr. Mathes Over Point in Electric Range Metering

To the Editors of the ELECTRICAL WORLD:

I wish to take exception to the statement by C. F. Mathes on page 431 of the March 1 issue of the ELECTRICAL WORLD that a 110-volt polyphase meter on a single-phase, 110-220 volt three-wire balanced load would not be accurate were the neutral fuse removed. This assertion is made in the last paragraph of his letter of comment on William Quandt's mention of using polyphase meters for more accurate registration of single-phase, three-wire range loads. If the load were balanced, the removal of the neutral fuse on either side of the polyphase meter could not affect or alter the voltage across the potential coils and hence would not affect the registration by the meter.

A disadvantage in using a polyphase meter for this class of service is the chance of one of the potential coils of the polyphase meter opening, which would not cause the meter to be totally non-registering, as in the case of the single-phase meter, but would register the current used on the one side, thus probably allowing the meter to remain in service for a time at least, with consequent loss of revenue.

FOSS C. HUSH,
Meter Superintendent.
Continental Gas & Electric Corporation,
Omaha, Neb.

Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

System Operating and Dispatching Board

By A. P. Broadhead

Superintendent of Power, New York State Gas & Electric Corporation, Oneonta, N. Y.

TO AID dispatchers in checking operations on the entire system, and also to give at all times an indication of the condition of equipment, the New York State Gas & Electric Corporation uses a control board, a portion of which is shown here. Battery switches are used to represent every switch on the transmission system as well as every generator switch. Lights are not used on this board.

The board is 12 ft. square and has painted upon its white surface the high-tension lines, substations, power plants, switch towers, etc. One-half of the system is operated on a 13-kv., three-phase, 25-cycle system and the other half on a 44-kv., three-phase, 60-cycle system. The systems are tied together through frequency changers. Power is generated at 13,000 volts, 2,300 volts and 3,300 volts, these voltages being represented by different colors on the board.

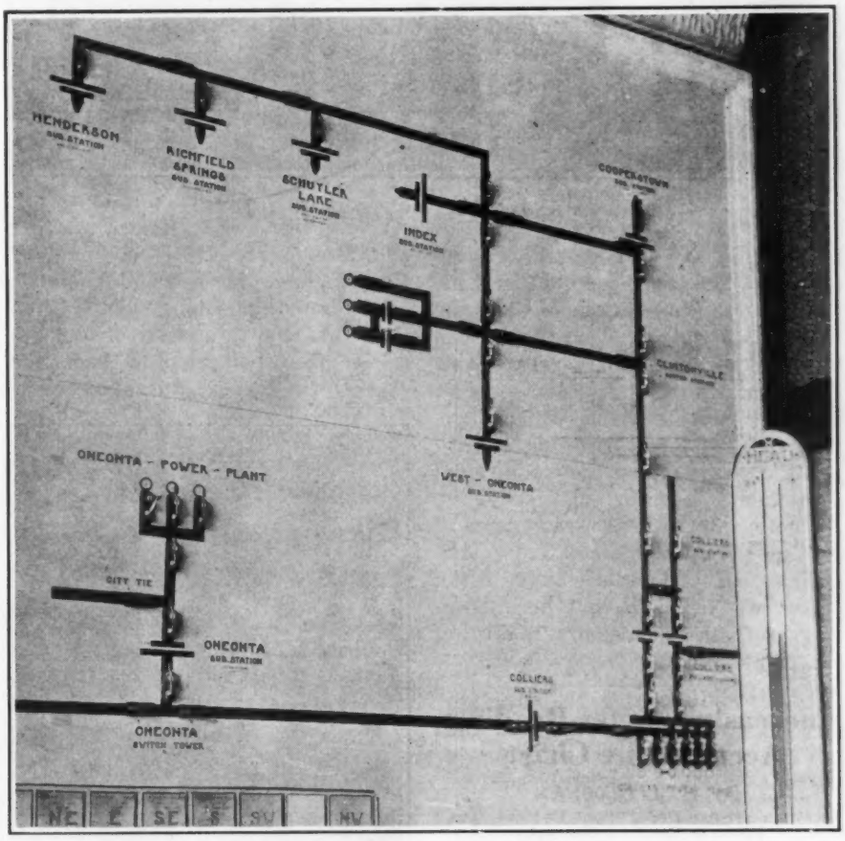
All transmission-line poles are numbered, and spare poles, cross-arms, pins and insulators are distributed along the line for emergency repairs. The location of this equipment is designated on the board along the different lines, thus: "1789 S.P.C.R." means spare pole at cross-road at pole No. 1789. The spare cross-arms and insulators are hung on the transmission-line poles about 8 ft. from the ground in plain sight, and but few are found broken maliciously. This arrangement of the board enables the system operator to tell at a glance without a card system the location of spare transmission-line equipment so that he can direct the repair gang or patrolman to the nearest supply point.

The various generators in the generating stations are numbered and their rating is shown. The substation capacities are also marked, stating the number of transformers in each bank and the capacity of the high-tension fuses. In addition to this information, all railroad-line crossings are marked as well as river crossings and long spans.

Whenever switches are operated for repairs, adjustments, etc., proper authority is secured from the system operator, who opens and tags the corresponding switches on the control board. The tags show the date, switch number, whom it was opened for, the time and who cleared the switch. The actual switches bear similar tags.

The patrolmen are each equipped with two grounding devices consisting of a braided copper ribbon about ½ in. wide and 50 ft. long with a suitable weight on one end and a clamp on the other for attaching to ground. When the line is pronounced dead the repairman short-circuits and grounds the line each side of where he is working. The grounding device is found to be much better than a chain, which is liable to kink and corrode and make poor contact besides abrading the conductors. A chain is heavy to carry; the copper ribbon on the contrary is very light, flexible and compact.

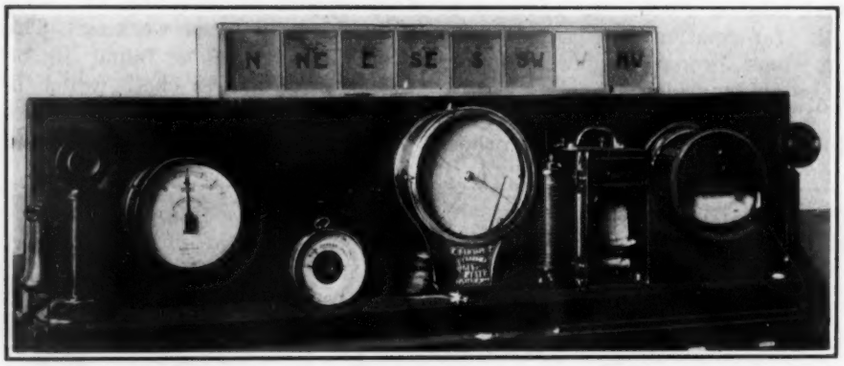
In addition to the control board the system operator has meters recording voltage, frequency, etc., on his desk, besides gages which show the net available head at the different hydro plants and the standing



PORTION OF DISPATCHING BOARD ON WHICH 25-CYCLE AND 60-CYCLE SYSTEMS ARE COMBINED

of the main tributary creeks—whether they are low, rising, normal, etc. This information is telephoned in at regular intervals, and gages are set to indicate the condition.

There is an electric weathervane devised by the writer which indicates to the operator the direction of the wind. A view of the weathervane indicator is shown herewith, also a portion of the operating board above. This wind indicator is of great importance to the operator in that it enables him to keep general track of storm movements by the aid of a barometer. Each power plant



WIND INDICATOR AND INDICATING METER AID LOAD DISPATCHERS

is required to report to the system operator the approach of storms, particularly thunderstorms, and by the aid of the weathervane he can tell whether the storm reported is traveling toward the system or just over the section from which it is reported. If it is traveling toward the system, he can get additional equipment ready for emergency.

Photographs of the various generating-station switchboards and outdoor substations are hung in the operator's room so that he can always refresh his memory regarding the plant layout.

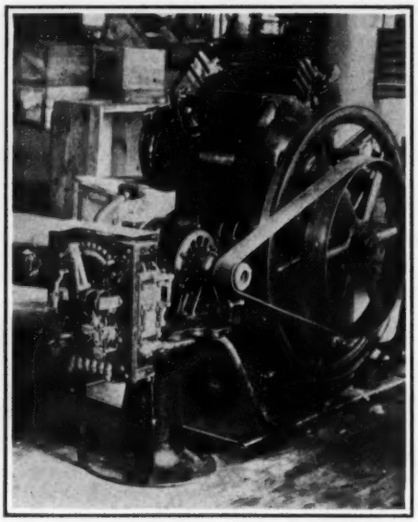
Increasing Meter-Reading Accuracy by Charts

BY H. J. CLOONAN
Foreman Service Department El Paso (Tex.) Electric Railway Company

A WAY has been found to increase the efficiency of the men in the service department of the El Paso Electric Railway Company who read and install meters. A performance curve for each man is plotted showing his percentage of accuracy. This is computed from the number of meters read on cut-ins and cut-outs and the number of mistakes made by each man. A summary curve for the entire department is also plotted on the same sheet, which is then posted in a conspicuous place. All of these curves are brought up to date each week, and their use has stimulated a healthful rivalry among the men and has increased individual and departmental efficiency several per cent since the adoption of the system.

Unit Mounting of Press Motor and Control

A WELL-BALANCED motor and starting-box mounting in connection with the driving of a printing press at the plant of the Dennison Manufacturing Company, Framingham, Mass., combines space economy with minimum floor obstruction. As shown herewith, a pedestal carries both motor base and starter, the latter being stiffened by



MOTOR AND CONTROL ARE ASSEMBLED IN MINIMUM SPACE

angle-iron braces. A short belt run is required, and the wiring is carried in rigid conduit run in a single plane close to the press. Although the unit is relatively large in comparison with the size of the press, the space economy is striking.

Hard-Pine Cross-Arms Cost $0.81 Apiece to Make

BY J. M. STUART
Narragansett Electric Lighting Company, Providence, R. I.

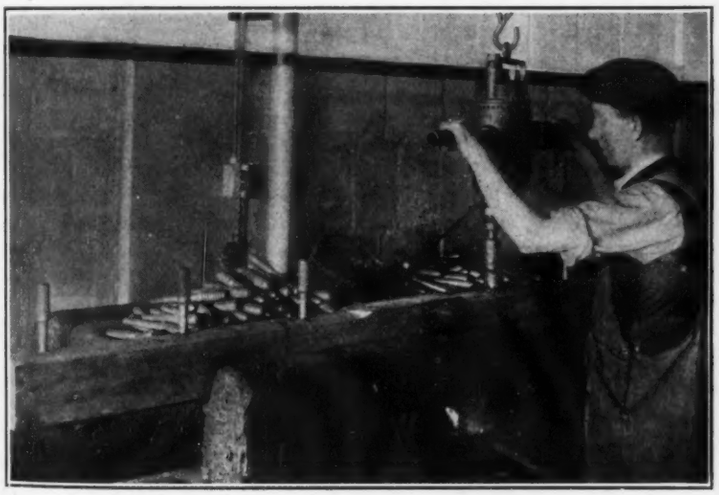
FOR several years the Narragansett Electric Lighting Company has manufactured its own cross-arms, believing that on account of cost, quality and promptness of delivery its own product is superior to that obtained through the usual commercial channels. At the new Melrose service station of the company a small shop has been provided for cross-arm manufacture in which hand labor has been cut to a minimum. Specifications require long-leaf yellow pine free from saps, shakes and unsound knots, dimensions 4 in. x 5 in. planed on four sides, chamfered with a $\frac{3}{8}$-in. arc on the best narrow side of the lumber, bored with $\frac{11}{16}$-in. holes $3\frac{1}{2}$ in. deep for malleable-iron insulator pins, and gain space to be left square. The side of the arm is bored in the center with an $\frac{11}{16}$-in. hole for through bolt, with $\frac{3}{4}$-in. holes on each side for brace bolts, the distance being 19 in. from the center hole to the brace bolts. The advantage of making our own arms is that it enables us to select the best grade of lumber, to make sure that the best side of the arm is chamfered, provide a solid foundation for the iron insulator pins, and to insure the proper arc of chamfer. There is a vast difference between the quality of hard pine in the factory-made and the home-made arms. In many cases the former are constructed of swamp-grown pine, a $6\frac{1}{2}$-ft. arm being light and soggy, often weighing not over 15 lb., while the home-made arm often weighs 45 lb., contains no sap and is abundant in yellow pitch.

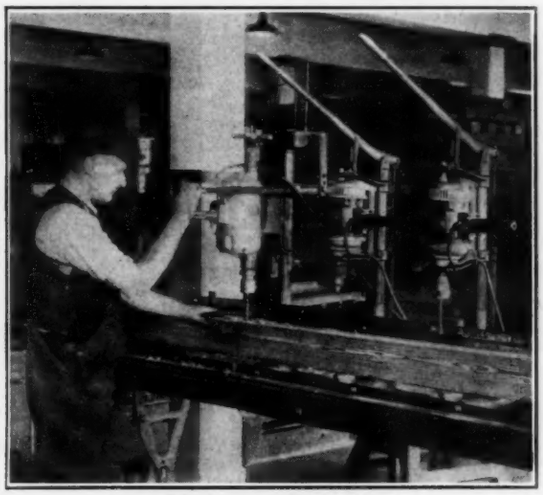
In our former purchases we did not succeed in obtaining the heavy stock now used in our own manufacture. This quality of stock is of vital importance in the life of the arm. Proper seasoning before painting is essential. Stock arrives in lengths of 20 ft. to 22 ft. It has usually been planed on four sides at the mill and is ready, when received, to be cut into the desired length. After sawing into $6\frac{1}{2}$-ft. lengths the arms are passed over the boring bench. In six hours 100 arms can be bored with 1,100 holes. They are then passed through the planer for chamfering or rounding of tops, to insure water shedding. A light, flat planer equipped with knives ground in a

concave arc serves the purpose. In one hour 100 arms are put through the planer.

The arms are then in the condition they would be if received from the factory. The work of "pinning," or equipping the arm with six pins to hold the insulators, is then done. The arms are passed into a slot in the pin bench and fastened securely. The workman takes six pins in one hand, and after dipping the points into thick paint, starts each one into the pin hole with one light blow of a hammer. A reversible drill, with a special chuck designed to screw over the iron pin, screws the pins, one at a time, to the desired depth, and by the use of the reversing lever backs off the pin, leaving it securely inserted into the arm. Formerly it was necessary to bore a 1½-in. hole through the purchased arm for a wooden pin, which weakened the arm; today only an ⅞-in. hole 3½ in. deep is required for the metal pin. Pins taken from arms in service twenty years can be used again in new arms. The pins used are of malleable iron, 7½ in. long with a ¾-in. shank and a 1-in. head, threaded 2 inches back to take a standard insulator. The other end is pointed and threaded like a lag screw. The pins are screwed into the holes only after being dipped into paint, and a weatherproof fit is secured. None of the old arms removed from service shows any decay starting around the pins.

The pinning and painting is a short process, and with due allowance for drying, arms can be used in three days from the beginning of work. About a week is usually allowed, however, to enable the paint to harden well before handling. With hard pine at $70 per 1,000 board-feet, a 6½-ft. arm containing 10½ board feet costs less than 75 cents for new stock. The cost of boring and chamfering is about 6 cents, making the total cost about 81 cents. While we are making them well within the factory costs, the main idea is to produce the best arm obtainable, thereby reducing later maintenance costs as well as making a safer construction job. In these notes no attempt is made to touch upon the relative merits of hard pine as compared with fir and other kinds of commercial lumber used in commercial crossarms. We believe that hard pine is useful in our case, where iron insulator pins are employed.





LEFT—IRON PINS ARE SCREWED HOME BY MOTOR-DRIVEN TOOL. RIGHT—ONE HUNDRED ARMS BORED IN SIX HOURS

Transformers Designed for Pothead Connection

TWENTY transformers embodying some interesting changes in design from previous types have recently been purchased by the Brooklyn Edison Company. They differ from former transformers in that instead of being equipped with the usual porcelain bushing for high and low voltage leads, these leads are taken out through potheads on the side of the tank near the top. The connections are made in the pothead, thus eliminating exposed connections and any possible grounding that might occur through anything touching the connection. Eighteen of these Westinghouse transformers are rated at 10,000-kva., three-phase, 60 cycles, and two at 6,000 kva.

The pothead construction consists of a sheet-steel box which is welded to the tank or cover, as the case may be, with oil-tight joints. Porcelain bushings extend through an oil-tight joint in the wall of the transformer tank into the pothead structure and serve as a connection means between the transformer leads and the transmission cable. The cable with lead covering intact is pulled through a pipe which is welded to the metal box of the pothead, and a wiped joint is formed between the outside of this pipe and the cable covering. Just inside the metal box the lead covering of the cable is peeled back and the cable insulation is then cut away on a gradual taper from that point to where connection is made with the bushings that lead into the transformer tank. In the case of three-phase cable, the conductors of the different phases are separated gradually as the insulation is reduced.

In the case of the 10,000-kva. units the potheads are placed on opposite sides of the main transformer tanks, and on the 6,000 kva. units one of the potheads is placed on the side of the tank and the other on the cover. The 10,000-kva. units are designed for 26,400 volts delta high voltage to 4,600 volts star low voltage, with the exception of three units which are for 26,400 volts delta to 6,600 volts star. The 6,000-kva. units are for 27,600 volts to 2,300 volts delta.

Showing Foremen How to Get Co-operation

THE following suggestions which have been issued to foremen of the Oklahoma Gas & Electric Company by its department heads are intended to help them get the co-operation of their men:

1. Be fair. Have no favorite and no scapegoat. A foreman has to act as a judge many times and must be just.
2. Make few promises and keep them. A foreman must be exact in this particular.
3. Don't waste anger. Use it. Keep

your most forceful language for special occasions.

4. Always hear the other side. Never blame a worker until he has given his point of view.

5. Don't hold spite. Forgive. When you have had to scold a worker, go to him later and show him his fault in a friendly way.

6. Never show discouragement. Never let yourself be beat. A foreman must have perseverance and a "never-say-die" spirit.

7. Notice good work as well as bad. Let the workers see that you can appreciate as well as condemn.

8. Watch for special ability. Take a keen human interest in your workers. Put each one where he can do his best.

9. Take your full share of the blame. This is the most difficult of all. The foreman who can share both blame and praise with his workers has discovered the secret of managing men.

10. Prevent accidents. Educate or eliminate the careless man.

Overhead Distribution Construction

Standardized Practice as Developed and Used by the
WEST PENN POWER COMPANY, PITTSBURGH

Construction Details for Overhead Lines

Sag.—For all ordinary lines in level country the sag of conductors shall be determined by sighting between cross-arms on two adjacent poles which have the standard spacing. The proper sag shall be selected from Table XI, depending on the length of the span and the material and size of conductor. The sag should be slightly reduced in cold weather and increased in hot weather. At crossings of lines of all voltages over railroads and at crossings of lines of more than 5,000 volts over telephone, telegraph or signal lines sags in the crossing span and in the adjacent span on each side of the crossing span shall be twice those given in Table XI. For all other conductors and longer spans refer to the distribution engineer.

Conductors should be pulled up to and held for a few minutes at a tension higher than normal and then be slacked off to normal tension. Normal tension for wires is given in Table XII. The tension should be increased in cold weather and reduced in hot weather.

Splices. — Splices in medium-hard-drawn and soft-drawn copper wires in sizes No. 2 and smaller (solid wire) shall be made as shown in Fig. 36A. The splice should be made so as to be mechanically and electrically secure before the solder is applied. The two ends to be spliced should be scraped perfectly clean and free from insulation (if insulated) for the necessary length; then each should be given one complete long wrap followed by four complete close wraps about the other. The ends of the wrap should then be cut close to the line wire and the entire joint well soldered. Solder should be used on medium-hard-drawn wire in such a way that it will not anneal the wires. The solder burrs should be wiped off from the lower end and the entire joint covered with friction tape to the same thickness as the insulation of the line wires.

Splices in stranded wires shall be made as shown in Fig. 36A. The ends to be spliced should be scraped perfectly clean and free from insulation (if insulated) for the necessary length and then unstranded. The strands should be spread, pulled straight and thoroughly scraped and cleaned. Dovetail or interlace the strands of each wire and pull them out so they all lie closely along the wire. The strands should then individually be served six times about the conductor and cut off close to the wire. The whole joint should then be thoroughly soldered and taped to the same thickness as the insulation of the line wire.

Taps.—For No. 4 and smaller wires taps shall be made by taking three complete long wraps of the tap about the conductor. Clean thoroughly and solder. For larger wires the tap shall be made by wrapping the tap tightly to the conductor with soft-drawn No. 16 wrapping wire. Clean thoroughly and solder. This is shown in Fig. 36A. All taps and connecting wires running from one level to another and from one side of the pole to another shall be made in vertical and horizontal runs and in such a manner as to maintain at all times the clearance required by Table VIII (see ELECTRICAL WORLD for March 22, 1924, page 580). All bends shall be made neatly at right angles and free from kinks; the radius of the bends shall not be less than 1 in.

Pin positions for various types of circuits are shown in Fig. 36B and transpositions in Fig. 36C and D. These will be further described in the next issue.

TABLE XI—PROPER SAG FOR DISTRIBUTION LINES

Span in Ft.	Sag in Inches: T.B.W.P. Copper M.H.D. Wire	No. 6 M.H.D. Bare Copper Wire	No. 4 M.H.D. Bare Copper Wire	Larger M.H.D Bare Copper Wire
100	12	9	9	9
125	18	15	15	15
150	24	24	21	21
175	36	30	28	26
200	..	36	38	..
250	..	..	71	..
300	..	..	115	..

TABLE XII—NORMAL TENSION FOR MEDIUM-HARD-DRAWN COPPER WIRES

Size Wire	Tension in Pounds T.B.W.B.	Bare
No. 6	120	120
No. 4	210	210
No. 2	340	400
No. 0	530	600
No. 4/0	1,000	1,200

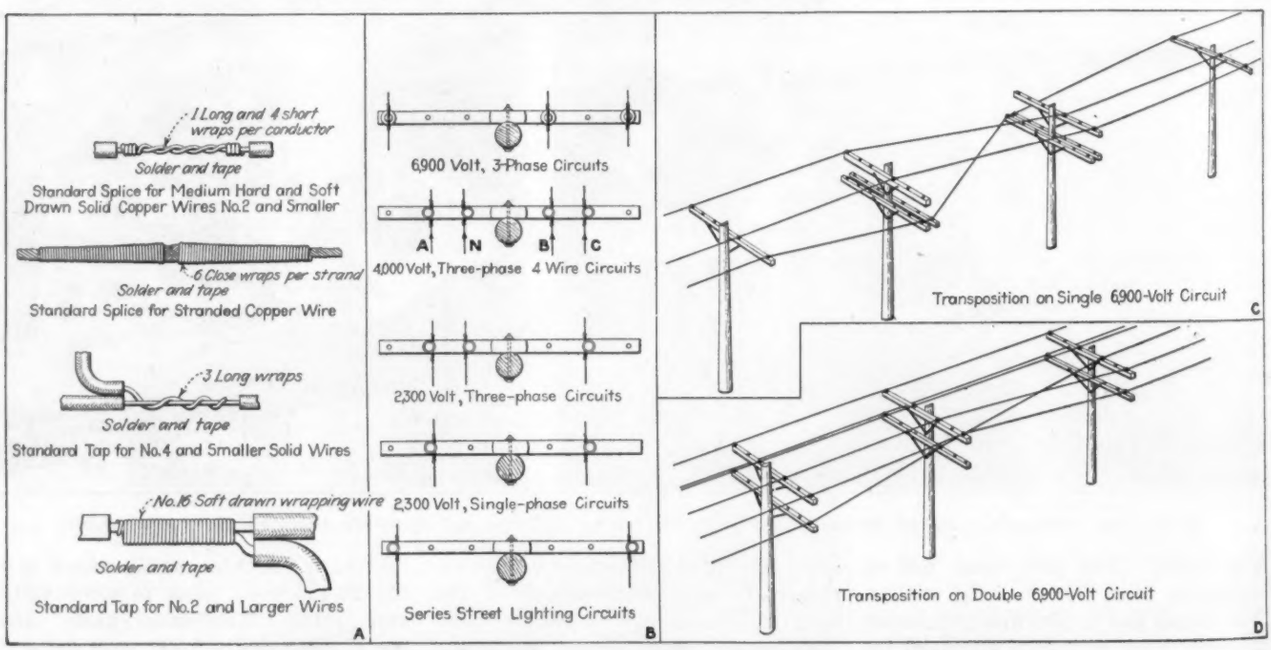

1 Long and 4 short wraps per conductor
Solder and tape
Standard Splice for Medium Hard and Soft Drawn Solid Copper Wires No.2 and Smaller
6 Close wraps per strand
Solder and tape
Standard Splice for Stranded Copper Wire
3 Long wraps
Solder and tape
Standard Tap for No.4 and Smaller Solid Wires
No.16 Soft drawn wrapping wire
Solder and tape
Standard Tap for No.2 and Larger Wires
A
6,900 Volt, 3-Phase Circuits
A N B C
4,000 Volt, Three-phase 4 Wire Circuits
2,300 Volt, Three-phase Circuits
2,300 Volt, Single-phase Circuits
Series Street Lighting Circuits
B
Transposition on Single 6,900-Volt Circuit
C
Transposition on Double 6,900-Volt Circuit
D

FIG. 36—SPECIFICATIONS FOR SPLICES, TAPS, CIRCUIT POSITIONS AND TRANSPOSITIONS

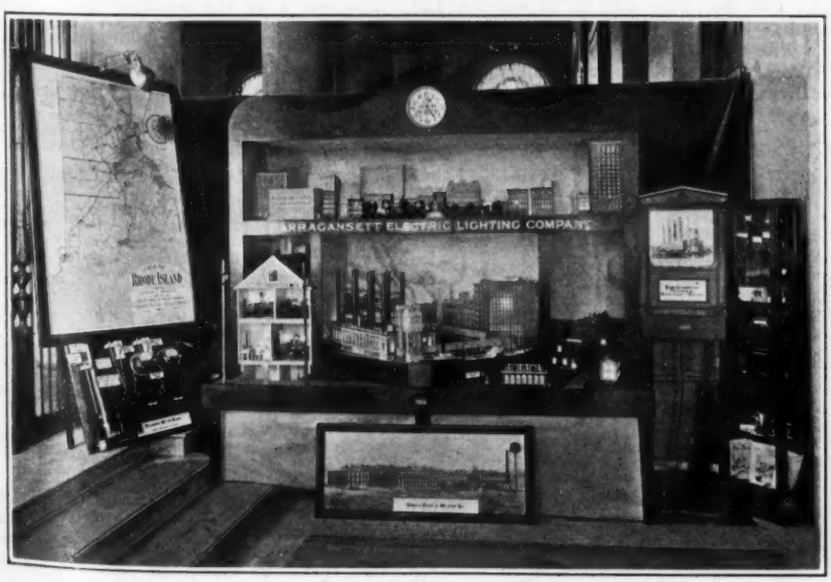
Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

A Central Station Service Exhibit

AN ATTRACTIVE exhibit of plant equipment and service methods has recently been completed by the Narragansett Electric Lighting Company, Providence, for use at conventions, in office-building lobbies, schools, electrical homes and other places visited by large numbers of people. Between February 20 and March 1 the exhibit was shown at the entrance of the Rhode Island Hospital Trust Company's building, and it is estimated that it was inspected by more than 15,000 persons.

As shown in the illustration, the central portion consists of a model of the company's South Street generating station, with fuel-handling equipment, at the rear being a facsimile of the headquarters office building and a typical factory served by this utility, with a rural substation in the foreground. On the left is a miniature home, including many electrical appliances also in miniature, and at the top is a view of the Providence civic center. Various features of the company's work are shown in an "attractoscope," and the exhibit includes a map of the system, with the distribution of the company's 11,000 stockholders shown by the use of beads. A standard meter board and other equipment are shown, and a flasher is used to give appropriate lighting effects, this being timed to indicate the path of electrical energy production and delivery from the oil tanker to the customer. In the near future the exhibit will be displayed at Brown University, following a recent demonstration before the Rhode Island Agricultural Conference.



PROVIDENCE COMPANY TELLS OF PLANT AND WORK BY ILLUMINATED MODELS

Training Fifty Speakers for Public Utilities

TO PROVIDE men capable of addressing civic and commercial organizations on subjects pertaining to the public utility business the Rocky Mountain Committee on Public Utility Information, which operates in Colorado, Wyoming and New Mexico, is engaged in training fifty utility department heads and assistants for public speaking.

It is planned to give these embryo speakers at least one year of training and practice before permitting them to speak in public. To a number of the men special subjects have been assigned. Each will specialize and make a study of the subjects assigned to him in all its phases.

Advertising Utility While Public Is Friendly

A YEAR'S advertising campaign designed to tell the public about its business and service has been begun in Buffalo newspapers by the Buffalo General Electric Company. It is significant to note that this series of advertisements has been started at a time when the company stands especially well in the favor of the public. The company has not waited for some one to attack it or for some unfavorable bit of legislation to be proposed before going before the public with paid advertising space to present its case. So far as is known, the company has no enemies in its territory. Even though this situation of having little adverse publicity to contend with might ordinarily be considered ideal from a public utility standpoint, there still exists a need for constructive publicity, in the opinion of officials of the company.

The fourteen-story octagonal stone tower, with its 7,200-cp. searchlamp, which the Buffalo General Electric Company uses for offices has for years been one of the most con-

INTRODUCING
An Old Friend
THE Electric Tower has become Buffalo's Symbol of Service. It serves as a constant reminder that here is a business enterprise, serving all the public, that conducts its affairs from the customer's point of view.
It is a symbol of our high ideals of service. Just as it seeks higher and higher levels above the streets, so is this Company always striving to be of more and more value to this community.
It stands solidly on a deep laid foundation of steel and stone, just as the Company stands solidly on a foundation of long years spent in giving the public a square deal, both as regards service and rates.
Hundreds of windows let in light from all sides, just as in Company affairs there is no closed book—all our policies and practices are open to public scrutiny, are matters of public knowledge.
We are proud of the Tower, but we take even greater pride in the fact that for 40 years this Company has given our great and growing City electric service unequalled anywhere.
BUFFALO GENERAL ELECTRIC COMPANY

CONSTRUCTIVE GOOD WILL ADVERTISING

spicuous architectural units in the city, and without intention on the part of the company it has become a trademark of its service. Therefore the electric tower is introduced in the first advertisement of the series as "Buffalo's symbol of service," and a cut of the building is carried in each of the twenty-four advertisements to appear throughout the year.

The facts that an overwhelming majority of stockholders of the company are just average American citizens who have their homes in Buffalo, that the company serves 130,000 customers twenty-four hours a day for 365 days of the year, that electrical service is universal—on the streets, in the shop, in the home—these are some of the things brought out in the early advertisements of the series.

The Buffalo General Electric Company's present campaign is based on the conviction that if every one in the city knew as much about the company's affairs as its own officials, there would never be any political agitation against it, and conversely the officials and employees of the company would be so committed to a policy of 100 per cent service to the public that many careless slips and errors would be avoided in the future.

Partial Electrification Leads to Full Use of Central-Station Power

Trial Installation of Motor Drive for One Manufacturing Unit May Act as Entering Wedge—Methods of Investigating and Comparing Costs

BY G. W. QUENTIN
Contracting Department, Duquesne Light Company, Pittsburgh, Pa.

CHANGEOVERS from steam drive to central-station power are often delayed because the proposed plan calls for complete electrification of all machinery. This not only involves a considerable financial outlay at one time, but also there is an element of doubt in the mind of the prospective power user as to whether the actual economies will be so great as estimated. In such cases, where the process of manufacture makes it feasible, it is advantageous to the power company to electrify one unit of the plant in the manner of a trial installation.

This practice worked out exceptionally well in the case of a steel company in Pittsburgh. An investigation of power costs of a typical unit in the plant was made and as a result of the findings a 16-in. and 10-in. mill was electrified. In operation it has worked out so satisfactorily that the steel company now plans to complete the electrification as rapidly as possible. The method of making the survey, together with the savings to be realized by using central-station energy, are shown in the following analysis prepared by the Duquesne Light Company's contracting department.

In presenting the report of the survey a comparison of the costs of steam and electric operation is shown in summarized form so that the customer may see at a glance the extent of the savings to be effected.

The object of this survey is to show the comparative operating costs of the 10-in. and 16-in. mill between the present steam-engine drive and proposed motor drive using Duquesne Light Company service.

Present Operation.—A 36-in. x 48-in. Mackintosh & Hemphill single-piston-valve engine drives both mills. The 16-in. mill is directly connected to the engine shaft and the 10-in. mill is belted to the flywheel. The schedule of work determines the speed at which the engine is operated. This varies from 50 r.p.m. to 90 r.p.m. The steam pressure at the engine varies from 85 lb. to 135 lb. The mill is in service 128 hours a week.

The approximate length of the steam line between engine and boilers is 1,450 ft., varying in sizes from 8-in. to 24-in. pipe. The drop in pressure is from 15 lb. to 20 lb. The steam pressure at the boilers varies from 100 lb. to 150 lb.

The average monthly tonnage of this mill is 1,200.

Billets 4 in. x 4 in., weighing 150 lb. each, were being rolled to $\frac{9}{16}$ in. round in seven passes in the 16-in. roughing mill and eleven passes in the 10-in. finishing mill. The reductions were as follows:

SIXTEEN-INCH MILL

Pass No.		Pass No.	
0	4 in. x 4 in. square	4	2½ in., diamond
1	3½ in., diamond	5	2¼ in., diamond
2	3¼ in., diamond	6	2 in., diamond
3	2¾ in., diamond	7	1¾ in. square

TEN-INCH MILL

Stand No.	Pass No.	
1	1	1½ in., square
..	2	1$\frac{7}{16}$ in., square
..	3	1⅜ in., square
..	4	1 in., square
..	5	1 in., square
..	6	Oval, $\frac{7}{16}$ in. thick by 1¼ in. wide
2	7	¾ in., square
3	8	¾ in., diamond, open angle 110 deg.
4	9	$\frac{11}{16}$ in., square
5	10	Oval, $\frac{11}{16}$ in. thick by $\frac{11}{16}$ in. wide
6	11	$\frac{9}{16}$ in., round

Indicator cards taken showed the following results:

Card No.	Steam Pressure	R.p.m.	Indicated Hp. Head End	Indicated Hp. Crank End	Indicated Hp. Total
1	115	89	83.5	77.2	160.7
2	115	89	77.4	73.6	151
3	120	87	146	143.5	289.5
4	120	88	144	135.8	279.8
5	120	83	214	155	389
6	115	83	248	188.5	436.5
7	110	76	592	376	968
8	110	75	600	558	1,158
9	110	733*	392	602	994
10	110	70	595	436	1,031
11	110	70	592	366	958

* Ten minutes.

Maximum indicated horsepower from cards No. 8 and No. 9, 1,202.

Cards Nos. 1 and 2: Friction load of 16-in. roughing mill, including pulley and belt friction to 10-in. mill. Engine speed, 89 r.p.m.

Cards Nos. 3 and 4: Friction load of both 16-in. and 10-in. mill. Engine speed, 88 r.p.m.

Card No. 5: Both mills running. The card of the crank end was taken during pass No. 5 and that of the head end during pass No. 6 of the schedule given above. Engine speed, 83 r.p.m.

Card No. 6: Same conditions as No. 5 card.

Card No. 7: This card was taken under actual rolling conditions at a time when there was no metal in the 16-in. mill. There were three or four pieces in the 10-in. mill. The speed of the 16-in. mill was 76 r.p.m. and that of the 10-in. mill 250-r.p.m.

Card No. 8: This card was taken with metal in the 16-in. and 10-in. mill. Integrator readings were taken for two five-minute periods. Seven billets entered the 16-in. mill during the first five-minute period and five billets during the second five-minute period. The integrator was stopped one minute between the two periods, in which time two billets entered the 16-in. mill. This would make a total of fourteen billets over the eleven-minute period.

Cards Nos. 9, 10 and 11: These cards were taken under actual rolling conditions as a check on No. 8 card. Integrator readings taken over the ten-minute period showed an average of 518 indicated horsepower-hours.

The steam consumption was calculated from card No. 8 and found to be 45.8 lb. of steam per indicated horsepower-hour.

Estimated Monthly Steam Cost.—On the basis of the mill operating on a schedule similar to the one at the time this test was made the monthly steam consumption would be as follows:

YEARLY OPERATING COST WITH CENTRAL-STATION SERVICE

Yearly cost of energy	$26,880
Interest, at 6 per cent on $90,000	5,400
Depreciation, at 5 per cent on $90,000	4,500
Insurance, taxes, etc., at 4 per cent	3,600
Total	$40,380

SAVINGS EFFECTED BY USE OF CENTRAL-STATION SERVICE

Average monthly energy consumption, kw.-hr.	175,000
Fifteen-minute maximum demand, kw.	635
Load factor, per cent	38.4
Average monthly energy cost	$2,240
Yearly cost of electric service	$26,880
New rate per kilowatt-hour	$0.012
Investment required (approximately)	$90,000
Present yearly cost of steam	$73,450
Yearly cost with central-station service	$40,380
Yearly saving with central-station service	$33,070

Average indicated horsepower	518
Steam per indicated horsepower-hour	45.8
Average number of hours per month	500
Monthly steam consumption (518 × 45.8 × 500), lb.	11,862,000
Estimated monthly steam loss due to condensate while the mill is shot down is, lb.	380,000
Total monthly steam consumption and loss, lb.	12,242,000
At an average cost of $0.50 per 1,000 lb. of steam, the monthly cost of steam would be:	
12,242,000 lb. at $0.50 per 1,000 lb.	$6,121.00

Proposed Operation.—In accordance with recommendations of the Westinghouse Electric & Manufacturing Company two variable-speed field-control direct-current motors would replace the present steam engine. A 400-hp. motor would be required on the roughing mill and an 800-hp. motor on the finishing mill.

A 1,000-kw. synchronous motor-generator set operating at 80 per cent, leading power factor would be installed to furnish direct current to these motors.

Investment Required.—The cost of purchasing and installing all equipment complete and ready to operate, including one 1,000-kw. motor-generator set, one 400-hp. motor for roughing mill, one 800-hp. motor for finishing mill, three 500-kva. transformers, switching equipment and substation, is estimated at $90,000.

Monthly Energy Consumption.—The average monthly energy consumption is estimated as follows:

Average monthly output of mill, tons	1,200
Average kilowatt-hours per ton	100
Direct-current requirements (1,200 × 100), kw.-hr.	120,000
Motor-generator set and transformer losses estimated at, kw.-hr.	55,000
Total monthly alternating-current requirements, kw.-hr.	175,000
The fifteen-minute maximum demand is estimated at 635 kw. Load factor = 175,000 ÷ (635 × 720) = 0.384 or 38.4 per cent.	

MONTHLY COST OF ELECTRICITY

		Energy Charge
200 kw.-hr., at $0.06		$12.00
23,900 kw.-hr., at 0.027		645.30
48,200 kw.-hr., at 0.0135		650.70
102,700 kw.-hr., at 0.007		718.90
Total		$2,026.90
		Demand Charge
100 kw., at $1.50		$150.00
535 kw., at 1.00		535.00
Total		$2,711.00
Discount of 8.82 per cent for maintaining unity power factor	$239.19	
Discount of 5 per cent for high-tension service	135.60	
Discount if paid within ten days	97.00	$471.79
Monthly net bill		$2,240.11

Central Station Plans Rural Sales Program

ONE of the smaller Western power companies, one which serves several communities in a farming district, has analyzed its merchandising problems in a way to set up a sales program for the entire district. A comprehensive plan of advertising outlines the field to be covered in newspaper advertising. This is to be supplemented by direct-by-mail appeals addressed particularly to the farmer. In addition, an auxiliary campaign of dealer contacts is planned, paralleling the efforts of the power company, so that the enthusiasm and force of the entire electrical group shall be behind each month's schedule. In this way the power company becomes the directing leader of its district, assisting the dealers' efforts in the same field. The year's program is outlined here.

What Other Companies Are Doing

Hartford, Conn. — To commemorate the careful work of the late James E. Macauley, general foreman of underground distribution, the Hartford Electric Light Company has established a trust fund of $50,000 bearing Mr. Macauley's name, the income to be devoted to accident prevention in electrical distribution and to the relief of suffering resulting from accidents. In each six months' period, if no fatal accident occurs, the income is to be divided among those employees of the company engaged in construction and maintenance of wires and cables. In case a fatal accident occurs in a six months' period, the income is to be used by the company in fulfilling its obligations.

Portsmouth, N. H.—At a "family meeting" of the employees of the Portsmouth Power Company held at the Rockingham Hotel, Portsmouth, N. H., Feb. 24, the Insull medal for resuscitation was awarded to Joseph Belmont, a foreman in the line department, this being the first award of the medal in New England. One hundred and fifteen employees attended.

Advertising Schedule of Central-Station Company Serving Rural Communities

Newspaper Advertising	Direct-by-Mail Advertising	Commercial Department Activities
JANUARY **Kitchen Lighting** Also, ask your dealer to show and explain the many convenient and labor saving devices. Mention electric appliances.		Work on dealers to put in displays of kitchen-lighting devices, also to run special advertisements. Dress company's windows—show proofs of advertisements. Get newspapers to solicit dealers for tie-up advertisements.
FEBRUARY Same as January.		Call on consumers, placing all orders through dealers. Keep after dealers.
MARCH **Appliances**	To farmers on electric ranges and water heaters.	Work on dealers to display and advertise appliances. Use proofs of company's advertisements and show mail plan to farmers. Urge newspapers to solicit dealers for tie-up advertisements.
APRIL **Appliances** or idea of "Electric power to do your work."	To farmers on pumping and motors for chores.	Same as for March, with additional work on motor and farm devices. Explain mail campaign directed at farmer.
MAY One large advertisement on what work electricity will do, including odd uses such as egg hatching and chick brooding. One large advertisement on proper wiring of homes	To farmers on electric ranges and water heaters.	Explain to dealers the mail campaign on ranges. Get their co-operation. Work with architects, builders, etc., on proper wiring. Get newspapers to solicit dealers to tie-up with advertising.
JUNE **Window and Store Lighting**		Work on merchants, shop owners, etc., referring all sales to dealers. Explain to dealers and get their co-operation, with special advertisements and displays of fixtures, etc.
JULY Small advertisements, brief text on "Let electricity do your chores," mostly display, reminder and carry-over stuff.		Keep in touch with dealers. Show proofs of advertisements.
AUGUST Same as July		Same as July.
SEPTEMBER **Electric Labor-Saving Appliances**	To farmers on motors, washing machines, sweepers, etc.	Work with dealers to get co-operation on special displays and advertising. Show proofs of advertisements and explain mail campaign. Get newspapers to solicit merchants for tie-up advertisements.
OCTOBER **Better Home Lighting** Also, bring in kitchen lighting.		Work with dealers to display lamps, shades, fixtures, etc. Show proofs of advertisements. Get newspapers to solicit dealers for tie-up advertisements and to run articles on home lighting.
NOVEMBER **Electric Portable Type Room Heaters** restricted to emergency and short period heating, such as bathroom, etc. Mention electric appliances.		Get dealers to display these devices and advertise them. Show proofs of advertisements. Get newspapers to solicit dealers for special tie-up advertisements.
DECEMBER **Electric Appliances** as gifts.		Urge dealers to make special displays and run special advertisements. Get newspapers to solicit merchants for special advertising.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Photostat copies or English translations of complete articles will be furnished at cost upon request

Hydro-Electric Development and Steam Equipment

Horizontal-Shaft Francis Turbines.—C. REINDL.—For low-head hydro-electric plants the vertical-shaft type of water turbine is used as a rule. Among the chief disadvantages of this type are the poor accessibility of the turbine itself and the usual very low speed, requiring expensive generators. Introducing, as has been done in some plants, a gear drive between wheel and generator relieves the latter, but not the former, shortcoming. Three rather unusual stations are described in this paper which employ horizontal-shaft Francis twin waterwheels operating under hydraulic heads of 2½ m. to 7 m. with speeds of 125 r.p.m. to 250 r.p.m. Developing from 800 hp. to 2,000 hp., these sets are suitable for direct coupling to standard generators. An axially offset arrangement of the units in relation to each other reduces considerably the otherwise excessive floor space. A 1,760-hp. hydro-electric unit running at 125 r.p.m. at a head of 4.3 m. measures axially over all 63 ft. The article contains twelve sectional drawings of these three stations, showing the favorable arrangement of such horizontal twin turbines.—*Zeitschrift des Vereines Deutscher Ingenieure*, Feb. 9, 1924.

New 14,000-Kw. Station at Williamsport.—The site of the power station of the Potomac Edison Company at Williamsport, in western Maryland, was selected on account of its being near the center of load and for the availability of water for condensing purposes, especially with regard to future requirements. The initial installation is for 12,000 kw., while the ultimate installation will be 150,000 kw. Structural features of the power plant and some of the mechanical features of the equipment are discussed.—*Power*, March 4, 1924.

Generation, Control, Switching and Protection

Use of Fuses for Obtaining an Exact Time Element.—W. WILSON.—The author deals with the use and performance of fuses and their time-element features and discusses methods whereby their characteristic curves may be drawn. In dealing with the time-element curves the author draws attention to the following sequence of events. First, the mass of metal in the wire of the fuse has to be heated until at least a portion of its length has been raised from the ambient temperature to the melting point of the metal. Second, the metal must be changed from the solid to the liquid form, passing through a pasty stage, during which the tendency to flow greatly increases. Third, the gap between the ends of the wires hardens, drawing out the arc to extinction when the circuit is finally broken. With regard to advances in overload protection, the author strongly advocates the use of the thermal delay principle.—*World Power* (formerly *Beama*), February, 1924.

Calculation of Electric Bushings.—J. LABOURET.—Electric bushings which are mounted in grounded parts, such as covers of oil switches, transformers or building walls, should be so designed as to have sufficient creepage, puncture and flashover safety. While creepage and flashover are determined chiefly by the voltage and can be taken care of by proper dimensions, the safety against puncture of a bushing will depend upon the configuration and density of the electrostatic field between the live part and the grounded portion. It is the purpose of this mathematical article to show how equipotential lines of the electric field may be calculated and how these theoretical results may be used to determine the actual shape of the insulation on a bushing. It is shown that the field between the central conductor of a bushing and its grounded collar varies according to a hyperbolic curve, and that operating conditions can be improved with increasing diameter of the conductor and a height of the ground collar at least equal to the diameter. Any concentration of the electric field, such as occurs at all sharp edges, should be carefully avoided.—*Revue Générale de l'Electricité*, Feb. 9, 1924.

Transmission, Substations and Distribution

Maximum Efficiency on Transmission Lines.—C. MEZZADRI.—Starting from the Blondel formulas on long transmission lines, the author shows that for a transmission line of given length and constants there exists one positive value of the power factor at the end of the line, for which the efficiency of the line has its maximum. To this value of the power factor corresponds one value of the ratio V^2/P, where V is the voltage and P the amount of power to be transmitted per phase. It is demonstrated that for a given value of the power factor at the distribution point of a line the curve which determines the variations of the voltage with the variations of the amount of power to be transmitted is a parabola when the efficiency is maintained at its corresponding maxima. This study is very theoretical, and it is completed by practical examples.—*Elettrotecnica*, Dec. 25, 1923.

French 60,000-Volt Cable.—A CURCHOD.—At the recent electric exposition in Paris a reel of underground cable was shown designed for three-phase, 60-kv. operation capable of carrying 300 amp. Three-phase circular stranded-copper conductors of 150-sq.mm. cross-section each are placed at the corners of an equilateral triangle and are individually insulated. Over each insulated conductor a layer of "metallized paper" is wound, and all three conductors are bound with a layer of the same material. Outer layers of lead, a spiral steel strip and jute make the armor on the outside of the cable. The critical ionization potential of this cable is over 6,000 volts per millimeter. The resistance of the "metallized paper" is large enough to avoid undue internal circulating currents. The radial insulation on conductors is 12 mm. thick, the external cable diameter is 106 mm., the weight is 29 kg. per meter and the heating with 300 amp. shows a rise of 30 deg. C.—*Revue Générale de l'Electricité*, Feb. 9, 1924.

Units, Measurements and Instruments

Directions for the Study of Varnish-Paper and Varnish-Fabric Boards and Tubes.—For some time the British Electrical and Allied Industries Research Association has been engaged in the study of varnish-paper and varnish-fabric boards and tubes. In the past no standard method of testing materials of this class has been recognized, and therefore methods of test were developed. As a result of the investigations which have been carried out the tests described are recommended for the purpose of ascertaining the electrical, mechanical and chemical characteristics of varnish-paper and varnish-fabric boards and tubes.—*Journal of Institution of Electrical Engineers (England)*, February, 1924.

Electrical Telemeter.—BURTON MCCOLLUM and O. S. PETERS.—Development work has been in progress for several years at the Bureau of Standards on an electrical telemetric device suitable for the measurement of strains, forces, displacements and accelerations with the view of making an instrument remote-reading and remote-recording. Practical applications so far made consist of the following: (1) Measurement of loads in airplane stay cables during flight, (2) measurement of strains in airship girders during construction, (3) tests of bridge members subjected to live loading, (4) tests of airship girders and bridge members in the laboratory, (5) measurement of pull on pressure arm of dynamometer, and (6) measurement of pressure.—*Technologic Paper No. 247 of the Bureau of Standards.*

Illumination

Colored Lighting.—M. LUCKIESH and A. H. TAYLOR.—The spectral limits of the various colors are given, also the relative luminosity of the various portions of the spectrum from a 150-watt or 200-watt gas-filled lamp. The characteristics, advantages and disadvantages of various colored media are discussed. These media include colored glass lamps, colored glass accessories, gelatine filters, and colored lacquers and spray coatings for lamp bulbs. The transmission factors of many samples of such media have been measured and are given in this paper. The data show that many of the samples are much less efficient than they should be in order to produce satisfactory colors. The need for standardization is very evident. Two examples of recent large installations of colored lighting are described, with

connected-load data. A bibliography of colored lighting is included.—*Transactions of I. E. S.*, February, 1924.

High-Intensity Arc and the Parabolic Mirror.—FRANK BENFORD.—The high-intensity arc described in this issue and in the issue to follow is so radically different from the plain carbon arc that special testing equipment and test methods were found necessary for its photometric analysis. The essential feature of the arc is a deep and well-formed crater that is constantly filled with a highly luminous gas. The temperature of this gas is about 5,500 deg. absolute. The effective range of a high-intensity searchlight utilizing this arc is so great that there is some difficulty in making tests.—*General Electric Review*, March, 1924.

Motors and Control

Electric Drive of Rolling Mills—A. HARTMANN.—Modern electric drives of large rolling mills give preference to the three-phase induction motor, which has been developed in types specially suited for the rough and intermittent service. For rolling programs with extensive stretching and passes of long duration these motors are built now with the minimum of flywheel effect, which would in such cases act as a hindrance rather than a help. Friction losses in large rolls amount frequently to as much as 15 per cent to 40 per cent of the nominal output of the motor. Motors are made extremely sturdy, with very strong and symmetrical shafts. To simplify coil repairs on the stator, the latter can be turned coaxial to the shaft, so as to bring the fault, if it should be at the bottom of the stator, conveniently to the top. For starting these large motors an unusual water rheostat is described, permitting a starting torque of as high as one and one-half times normal torque. Concentric steel cylinders form the electrodes of the rheostat and can be slid more or less over each other. Their weight is counterbalanced by weights suitably placed at the end of levers. For intermittent starting the water capacity in these rheostats is sufficient to make the apparatus self-cooling, with the water temperature not exceeding 70 deg. C. For more frequent or steady speed regulation a radiator cooling system has to be attached to the starter.—*Brown-Boveri Mitteilungen*, February, 1924.

Use of Condensers with Squirrel-Cage Motors.—T. F. WALL.—As one of the various means of correcting low power factor the use of static condensers is discussed by the author, who confines his discussion to the case of the squirrel-cage motor with static condensers in series with the stator circuit. By connecting static condensers in series with the stator the characteristics of the motor are profoundly modified. An enormously increased starting torque is possible and the full stalling torque may be developed at starting. The power factor is also materially improved. By the use of an auto-transformer for starting the static torque can be made greater than full-load torque without increasing the starting current above a permissible value.—*World Power* (formerly *Beama*), February, 1924.

Electrophysics, Electrochemistry and Batteries

Modern Primary Batteries.—H. WARD and L. D. GOLDSMITH.—The present field of primary batteries, their construction and their capabilities and limitations are discussed. Three types of Laclanché cells are now in general use—wet cells, the so-called "dry" cells and inert cells, each of which is discussed. The author also considers the Lalande or copper-oxide cell, the Darimont cell, the air-depolarized Féry cell and the silver chloride cell. Dealing with some theoretical points of the primary cell, the author discusses the source of energy in the cell, the difference between theoretical voltages and the voltages actually obtained, the limitation of the voltage, the polarization of cells and the effects of temperature. The article also indicates the precautions necessary in the testing of cells and concludes with a short account of what has been done in the standardization of cells.—*World Power* (formerly *Beama*), January, 1924.

Thermal Conductivity Method for the Analysis of Gases.—P. E. PALMER and E. R. WEAVER.—Of the various physical characteristics of gases which offer possibilities for the development of gas-analysis instruments the thermal conductivity is probably the most useful. By a comparison of the resistance of two electrically heated wires surrounded respectively by the gas for analysis and a reference gas a determination is possible of the concentration of certain constitutents in a wide variety of gas mixtures of importance in industry and research. High sensitivity and great accuracy are secured at a relatively small expense, and the method is well adapted for either manual or automatic continuous operation. By the use of suitable auxiliary devices various automatic-process controls based on gas composition are easily arranged.—*Technologic Paper No. 249 of the Bureau of Standards.*

Traction

Electrification of Foreign Railways.—S. PARKER SMITH.—The author continues his articles on the world-wide development in railway electrification with one on the electrification of railways in Germany, considering in detail the electrified railways of Prussia, Bavaria and Baden. After the federalization of the state systems standard locomotives of six types were adopted, and it is considered that this step should reduce the cost of an electric locomotive to from two and one-half to one and one-half times that of a steam locomotive. The number of locomotives should be reduced to 70 per cent or 80 per cent of the corresponding number of steam locomotives, while upkeep and repair costs should fall greatly. Diagrams and tables are given showing the main characteristics of these standardized locomotives.—*World Power* (formerly *Beama*), January, 1924.

Safety Controller for Electric Cars.—A. BRODBECK.—The safety controller or "dead-man" handle described fully in this paper does not act instantly upon release, but within a distance which can be set at will to 300 ft. or less traveled by the car after letting go of the handle. This, the author claims, has the advantage that the motorman does not have to hold the handle continually. The device is actuated from the axle, which turns a threaded spindle. A small magnet presses a traveling nut against the threads of this spindle, and after traveling a predetermined distance along the spindle a contact is closed which opens the main switch and applies the brakes. If the handle is grasped again before the contact is closed, the traveling nut drops back to its original position, without having caused the car to stop. A large Swiss railway system has equipped all its electric locomotives with this apparatus and actual operating results have proved very satisfactory.—*Brown-Boveri Mitteilungen*, February, 1924.

Telegraphy, Telephony, Radio and Signals

Radio Station of Coltano.—G. VALLAURI.—The author gives a detailed description of the radio station of Coltano, Italy, which is one of the most powerful of the world. He describes the location of the various buildings, production of energy, distribution system, Poulsen arc converters, aërial inductance and system of manipulation, high-frequency alternators, telegraphy and manipulation rooms, aërial and towers, etc. The station, built by the Royal Italian Navy, is able to transmit with its present apparatus about 10,000 words a day.—*Elettrotecnica*, Jan. 5 and 15, 1924.

Clock-Controlled Tuning Fork as a Source of Constant Frequency.—J. G. FERGUSON.—Recent developments in carrier-current telephony and telegraphy over wires have placed exceedingly rigorous limits on the frequency of such types of apparatus. It is many times necessary to hold such equipment as oscillators or filters to within 0.1 per cent of a given frequency value under commercial operating conditions. This means that calibrating devices used in the manufacture and maintenance of such circuits must be reliable to 0.01 per cent. The author discusses one of the methods recently developed for obtaining a source of practically constant frequency. It consists of a clock-controlled tuning fork making fifty vibrations per second, and the maximum deviation of its frequency from the mean is less than one part in 50,000. A study has also been made of the means for improving the constancy of the control clock, and a new type of clock mechanism consisting of an electrically operated pendulum, the impulse of which is controlled by a photo-electric cell, is suggested as a solution of the problem.—*Bell System Technical Journal*, January, 1924.

Miscellaneous

SHAFT WHIPPING.—Dr. B. L. NEWKIRK.—Vibrations and shaft whipping have proved very troublesome in the operation of some machines, often putting limits on their performance. The author deals with an analysis of these disturbances and shows means and ways of prevention.—*General Electric Review*, March, 1924.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Million-Volt Testing Set

First Commercial Installation of This Rating to Be Used in Commonwealth Edison Plant

A MILLION-VOLT testing set has been ordered by the Commonwealth Edison Company from the General Electric Company for installation in a new laboratory which the Chicago central-station company is about to build. No testing set with so high a rating has ever before been purchased by an operating company. Its acquisition has been brought about by the continuous and rapid growth of the Commonwealth Edison's distribution system and the need to employ high voltages in testing and research. The equipment will not duplicate that in the high-voltage laboratory of the General Electric Company at Pittsfield, Mass., but will embody a later design of smaller size and greater flexibility.

The site of the laboratory will be adjacent to the Northwest generating station of the Chicago company. It is being designed by engineers from both that company and the General Electric. The building which will house the laboratory will be 100 ft. by 80 ft. in area and of sufficient height to permit ample crane clearance. Around the pit will be an observation gallery from which visitors may view the tests.

An immediate cause leading to the installation of the testing set is the projected 132-kv. transmission line around Chicago, which is to connect all of the industrial districts from the Wisconsin state line on down around the edge of the lake to the steel-mill district in and around Gary, Ind. The operation of this line will require tests at extremely high voltage on apparatus and equipment. The Commonwealth Edison Company is now supplying energy to a population of about three millions in Chicago and has a power load of more than 600,000 kw., apart from the outlying areas and manufacturing districts, which in many cases are supplied by allied companies. The new laboratory will be available to all companies under the management of Samuel Insull and his associates.

What Apparatus Consists Of

Heretofore the only million-volt equipment has been in the engineering laboratories of the companies manufacturing electrical apparatus. These laboratories have been making tests for some years at pressures in excess of a million volts, but the commercial application of such high-powered equipment is an innovation and a testimony to the growth in the load of the great central-station companies.

The apparatus of the new laboratory will include transformers, a special generating set, regulators, sphere gaps and measuring instruments. The testing set will consist of three transformers, each rated at 350 kva. and 350,000 volts. These transformers will be connected in series for testing up to 1,050,000 volts on single phase. When connected for three-phase work the transformers will be used for testing up to 607,000 volts. A 500-hp. motor-generator set (three-phase synchronous motor with three-phase generator, which can also be operated single-phase) supplies energy to the testing set. The generator is designed to give a pure sine voltage wave.

Federal Power Board on Boulder Dam

The Three Cabinet Members Call Attention to the Perils of Government Embarkation in Hydro-Electric Production and to Success of Present Policy

IN THEIR capacities as members of the Federal Power Commission, the Secretaries of War, the Interior and Agriculture have subscribed to a letter in which they disapprove of the Swing-Johnson bill for the government construction of Boulder Dam and call the attention of Congress to the situation where a general policy of federal development of electrical energy will lead. The letter begins with a consideration of flood protection and irrigation and their cost and of the proposed all-American canal.

"In so far at least as the project proposed exceeds the requirements of flood control and irrigation," continue the Secretaries, "the bill proposes that the United States shall undertake a new national activity, namely, the business of constructing facilities for production of electric power for general disposition, an activity which if logically pursued has possibilities of demands upon the federal treasury in amounts far beyond those now involved in reclamation and highway construction combined. While the United States has heretofore constructed power developments in connection with irrigation projects, these developments have been merely incidental to the projects, have been of a few thousand horsepower only and have been primarily for use on the projects themselves. The construction of a reservoir having a capacity of from four to eight times the needs of irrigation and flood control and of a power development twenty times in excess of the probable power needs of the irrigated lands and adjacent communities is a complete departure from former policies. The only undertaking by the United States at all comparable in magnitude with the proposals at Boulder Canyon is at Muscle Shoals, and this project was undertaken to furnish munitions in time of war. In so far as it was to serve the needs of peace, it was to furnish an essential commodity for all sections of the United States and was not for the special benefit of a limited area.

"If the United States is to embark upon a general policy of public development of electrical energy at federal expense, it should do so only after full consideration of what the step means. The present investment in the United States in central electric stations—that is, in those plants engaged in developing electric power for general distribution and sale—is approximately $4,500,000,000. That investment will require to be more than doubled in the next ten years if the demands of industry are to be met. A policy of federal development would therefore require continuous expenditures of not less than one half billion dollars per annum; for it could not be expected, in the face of such a policy supported by government funds and with tax-exempt properties, that private industry could afford to put any additional investment into the central-station business. Under such circumstances we must assume that any such policy or program of federal activities is impracticable and undesirable.

Boulder Dam Not an Exception

"If the proposal in H. R. 2903 [the Swing bill] with respect to power development is not the first step in a general program of like undertakings, it can be justified only on the clear proof that peculiar conditions in this particular case—conditions not prevailing elsewhere—justify the federal government in taking action that it does not propose to duplicate elsewhere. Such action cannot rest on the ground that the federal treasury is the only available source of funds—for private funds are available now and have been for several years to undertake immediately such development as is justified by the needs of flood control, irrigation and energy supply—or on the ground that the territory to which the greater part of the power must be delivered is in any immediate need of added power, for that territory is already better supplied and at a cheaper rate than any similar territory in the United States. It has been argued that the United States should finance this power development because with a lower interest rate, absence of profit

and freedom from taxation, power could be delivered at a less cost than if developed by private capital. This is by no means a necessary conclusion, but even if it were, electric power is only one element in industry, and if federal financing is justified in the present case on such grounds, it is similarly justified in all other cases and in all branches of industry. With the authority that exists in the states and in the United States to regulate and control private or municipal power development, distribution and sale, we do not believe that the United States should undertake such development unless it can be clearly shown that the development cannot otherwise be had.

Success of Federal Commission

"In 1920, after many years of consideration, Congress adopted a general national policy with respect to power development on sites under federal control. That policy has been attended with marked success. Millions of horsepower are being constructed under the terms of the federal water-power act. These sites are being held in public ownership under public control, with every essential public interest protected. There is no occasion for going outside of the terms of that act to secure the production of all the electric energy required at terms fair both to the developer and the user. Under such circumstances, we do not deem it desirable to enact special legislation modifying the established policy by giving to any individual, corporation or community special privileges not accorded to all.

"Congress also, in the federal water-power act, created a single executive agency for the administration of all water powers under federal ownership or control. The plan thus adopted is proving eminently satisfactory. We believe any change in such method of administration is undesirable, and therefore, whether the Boulder Canyon dam or some other be built and whether at public or private expense, we believe the disposition of any power developed should be handled by the Federal Power Commission under the general terms of the federal water-power act, and not as proposed in the bill. All interests of the Department of the Interior will be adequately met through the membership of the Secretary of the Interior on the commision."

An International Issue

In concluding their letter the Secretaries express doubt of "the advisability of the establishment through construction of rights in the lower states of such magnitude as would be involved in the proposed storage at Boulder Canyon" until the Colorado River compact is either accepted or finally rejected by Arizona. They also call attention to the international issue involved and declare it to be "highly desirable to reach a general agreement with Mexico on the problems of the lower river before extensive storage is provided in the United States."

A summary of the report of Col. William Kelly, chief engineer of the Federal Power Commission, on the Boulder Dam project will be found on page 640 of this issue.

Lamp Manufacturers Sued as Monopoly

Attorney-General of the United States Charges Violation of Sherman Anti-Trust Law and Demands the Annulment of Contracts with Distributors

IN A SUIT filed in the federal District Court at Cleveland on Thursday, March 20, by the United States district attorney the General Electric Company is charged with conspiracy in constraint of trade and in violation of the Sherman anti-trust law because of its method of manufacturing and distributing electric light bulbs, and the annulment of its contracts with the several companies engaged in the distribution of these incandescent lamps is demanded. This contract system is declared to have been created as a device to defeat the provisions of the anti-trust law and to prevent competition. The petition declares that the business of the firm amounts to probably $50,000,000 a year. The Westinghouse Electric & Manufacturing Company and the Westinghouse Lamp Company (described in the suit as "but a bureau or division of the parent company's business") are named as co-defendants, and the three companies are alleged to enjoy a monopoly of the lamp-manufacturing business. The suit harks back to patent rights claimed by the General Electric Company for exclusive manufacture of tungsten filaments.

Attorney-General's Statement

Attorney-General Daugherty in announcing the suit said: "The public interest will best be served by filing at this time a proceeding directed against the vast system of agency agreements and the license agreement between the General Electric Company and the Westinghouse company, to the end that all unlawful restraint of interstate commerce in connection with the sale of electric lamps may be eliminated and normal trade conditions restored." He added that the determination of the legality of the patent monopoly would be dealt with by such further legal action "as the public interest might require."

The investigation was based on complaints that the defendant companies had failed to comply with a decree entered against them by the federal District Court at Toledo, Ohio, on October 12, 1911. The Attorney-General said the "entire situation" had been subjected to a "thorough examination" by himself and his assistants.

Mr. Daugherty pointed out that in the year 1921 the General Electric Company did 71.9 per cent in value of the business in electric lamps in the United States, or $47,286,000; that the Westinghouse company, as a licensee of the General Electric Company, did 16.5 per cent of the business, or $10,864,000; that the other licensees of the General Electric Company did 8.8 per cent of such business, and that only 2.8 per cent of the electric lamp manufacturing business of the country was done by lamp manufacturers not connected in any way with the General Electric Company.

"This extremely small percentage of business done by independent lamp manufacturers," he said, "shows to how great an extent the electric lamp industry of the United States is controlled by the combination which the government attacks in this proceeding."

Statements of Swope and Cary

Regarding the government's complaint, Gerard Swope, president of the General Electric Company, said:

"In 1922 charges were made before the Lockwood committee of the New York Legislature against the General Electric Company's conduct of its lamp business. These charges the General Electric Company denied.

"On January 13, 1922, the General Electric Company requested the Department of Justice to investigate its lamp business and if in doubt as to the legality of its acts to bring an appropriate proceeding in court in order that the matter might be determined.

"Since that time the Department of Justice has made a most exhaustive examination of the practices and business methods of the General Electric Company and has now filed a suit in equity in the Ohio District under the Sherman anti-trust law. While I have not seen the complaint, I understand it raises the issue of our method of distributing incandescent lamps.

"The tungsten incandescent lamps which the company manufactures are covered by patents which have been sustained by the highest federal courts to which they could be taken. The patents are based on inventions largely the result of work in the research laboratories of the company.

"The distribution of lamps by consignment to agents, which I understand is the subject of the complaint above referred to, has been openly carried on for a period of twelve years. In 1915 the United States Circuit Court of Appeals of the Ninth Circuit held the contract on which this method of distribution is based to be a bona fide agency contract.

"In 1920, after investigating the method of distribution under these contracts, the Federal Trade Commission did not find any cause for complaint.

"Believing in the propriety and legality of its actions, the General Electric Company awaits with confidence the definitive decision of the courts."

Walter Cary, vice-president of the Westinghouse Electric & Manufacturing Company and also of the Westinghouse Lamp Company, made this statement: "The Westinghouse Electric & Manufacturing Company, through its subsidiary the Westinghouse Lamp Company, is engaged in the manufacture and sale of incandescent electric lamps which involve a number of patents not owned by the Westinghouse companies.

"The Westinghouse companies have a patent license covering the use of the patents necessary for the manufacture and sale of these lamps and they have been advised by counsel that this patent license and their conduct of the lamp business are in all respects legal and proper."

N. E. L. A. Educational Plan

Non-Commercial Movement to Instruct the Public in Principles of Lighting—Preserving Eyesight

AN EDUCATIONAL movement designed to give the entire public the benefit of the highest scientific and engineering achievements is assured as a result of formal action by the national executive committee and the executive committee of the Public Relations Section of the National Electric Light Association at their meeting in Chicago on March 14.

While the details of the plan will not be announced until the convention of the National Electric Light Association in Atlantic City in May, the movement is sponsored not merely by the National Electric Light Association, but by all the leading organizations which come into contact with the public in the electrical field. A special committee has been formed representing the various organizations and groups in this field, and the formal announcement will be made in the name of this committee, which is to be known as the lighting educational committee. The entire activity is to be non-commercial, the movement having grown out of the desire of the foremost men in the industry to give the public a better understanding of the correct principles of lighting.

Government officials and educational authorities have frequently called attention to the lack of general knowledge as to what constitutes good illumination. Conservation of eyesight through proper diffusion of light in the homes and schools of the nation will be one of the features of the general educational movement. James E. Davidson of Omaha, vice-president of the National Electric Light Association, has been named as chairman of the lighting educational committee and will direct the entire activity. In a statement issued this week, Mr. Davidson said in part:

"The use of electric light in the home has spread in the United States so rapidly that the industry itself feels the need for rendering a more comprehensive educational service that will really assist the public in conserving light and vision. The movement will be not merely national, but intensively local as well, and full facilities will be provided for placing at the disposal of the growing generation the knowledge of home lighting that will permit the application of scientific information in simplified, common-sense form."

Democratic Utility Bills Pass New York Senate

The bill reorganizing the Public Service Commission of New York State by abolishing the present body of five members, removable only by the Legislature, and substituting a commission of three subject to removal by the Governor, and also by restoring to the Legislature the power to make rates, passed the New York State Senate on Wednesday along with five other measures backed by the Democratic party and dealing with public utilities and projected public ownership in the State and in New York City. The Republican Assembly has passed the water-power bill prepared by its leaders. As already stated, there is scarcely a chance that any of the legislation will become law in view of the strictly partisan fight between the two houses.

Speakers' Bureaus Upheld

Illinois Association Hears of Their Work—The Farmer's Demands—Value of Better Lighting

PROGRESS reports concerning the formation of sectional public utility speaking bureaus, a presentation of the year's work on rural service problems and the sales value of improved lighting to central-station companies were the outstanding subjects of Wednesday's discussion at the twenty-third annual convention of the Illinois State Electric Association, held at the Hotel Sherman, Chicago.

With Illinois divided into ten districts for the purpose of more effectively training employees to give talks on utility subjects, reports on the first three months' operation of this plan were presented by the local committee chairmen. The purpose of these bureaus, according to John F. Gilchrist, vice-president Commonwealth Edison Company, is to get the employees to know their own utility problems well enough to spread this information in social gatherings and schools. Bert H. Peck said that the public at large was found to be open-minded toward utility problems and that the greatest difficulty lay in overcoming the mental inertia of utility operators themselves. B. J. Mullaney warned against allowing this new phase of public utility information to overshadow the good work done in the newspapers by the information bureaus. He enumerated four main subjects in which the public had shown interest—the position of a utility industrially and socially, the financial differences between utilities and other businesses, that service costs are not all profit, and that the question of rates involves commission regulation.

Dr. E. A. White, director of the Committee on the Relation of Electricity to Agriculture, discussed two farm problems facing utilities. The first one involved public relations. The farmer's isolation from the world has been broken down, and it is now necessary, he said, for utility men to show why rural service was more expensive than in cities. Dr. White thought that an explanation showing how utilities were merely rendering a service at cost plus a fair profit, as regulated by commissions, was the best way of handling the question. His second point was the need for developing equipment increasing the farm electrical load by distributing the cost over longer periods of time in order to lower the demand charges and make the service profitable to both utilities and farmers. Explanations of the commission's order regulating rural service in Illinois were offered by A. E. Worden, Bert H. Peck and E. H. Negley.

The discussion on J. M. Shute's paper on the value of lighting service to central stations was opened by Oliver R. Hogue, Chicago, who said that the results from the recent kitchen-lighting campaigns were excellent. Utilities, he felt, would never be finished with campaigns, because only a start toward increasing intensities had been made. Since a well-lighted kitchen contrasted most favorably with the other rooms, it would not be long before "drives" could be made profitably on lighting for these other rooms.

R. F. Schuchardt, dwelling on the advantages of superpower interconnections, at the same time alluded to the danger of conveying erroneous ideas to the public on this subject. The seven thousand miles of transmission lines in Illinois have, he said, lowered the number of unwired homes from 43 per cent in 1921 to the present figure of 25 per cent.

Thursday's sessions were devoted to a paper on electric range load developments by C. O. Dunten and a discussion of centralized management versus isolated units. The annual banquet was held Wednesday evening.

Water-Wall Boiler Furnace Is 92 per Cent Efficient

An efficiency of 92.7 per cent was announced as having been obtained in a redesigned boiler with economizer at the Hell Gate station of the United Electric Light & Power Company at a meeting of the Metropolitan Section of the A. S. M. E. in New York City on Monday evening of this week. The boiler design is by Thomas E. Murray, the essential features being that the ordinary side wall, usually composed of refractory material, is replaced by vertical 4-in. tubes set on about 7-in. centers with vertical fins welded to the tubes, the fins overlapping and closing the space between the tubes. These tubes form part of the circulating-water system of the boiler and in themselves absorb about 45,000 B.t.u. per square foot per hour. Outside of this water-tube wall are one layer of brick, a layer of "Sil-o-cel" and a steel jacket. The vertical tubes themselves are for safety's sake two gages thicker than standard. The boilers present 15,900 sq.ft. of heating surface with 13,800 sq.ft. of economizer and 7,430 sq.ft. in the superheater. Coal is burned on Taylor underfeed seven-retort stokers, each boiler being fired by a single stoker.

TESTS ON BOILER OF NEW DESIGN

	Test Number 3		Test Number 6		Maximum	
Rating, per cent.....	170		181		528 (¼ hour)	
Efficiency[1] per cent..	83.2		84.6		.....	
Efficiency[2] per cent..	89.6		92.7		.....	
	LB[3]	EE[4]	LB[3]	EE[4]	LB[3]	EE[4]
CO_2, per cent.....	11.69	10.91	13.04	12.01	15.2	13.8
CO, per cent.....	0.06	0.04	0.04	0.03	3.3[5]	4.0[5]
Per cent excess air...	60.1	71.6	38.4	49.7	....	....

[1] Without economizer. [2] With economizer. [3] Leaving boiler. [4] Entering economizer. [5] Due to insufficient furnace capacity.

The accompanying table indicates the results of three tests recently made on this boiler.

Meter Accuracy Discussed

Meter Section of Empire State Association Meets for Two Days at Buffalo

A DISCUSSION of the factors affecting the accuracy of watt-hour meters, indicating meters and instrument transformers by prominent men of both the central-station industry and meter manufacturing firms aroused wide interest in the annual meeting of the Electric Meter Section of the Empire State Gas and Electric Association. This meeting was held in Buffalo on March 20 and 21 and was attended by more than 160 meter engineers from nearly all the electric light and power companies in New York State. Laboratory standards and their application to working standards and the subject of testing and maintenance of relays were also discussed.

In a paper on "Inherent Accuracies in Electric Metering," by R. C. Lanphier of the Sangamo Electric Company, the two general sources of errors in watt-hour meters were taken up, namely, those arising from changes in the constants of the electric and magnetic circuits of the meter and those arising from variations in the mechanical forces acting to retard the moving system. It was shown how these errors are compensated so that meters of today are highly dependable instruments.

In the discussion it was pointed out that errors from overload due to the increasing use of appliances must be considered. Some meters with an overload of 100 per cent have an error of as high as 6 per cent. The plan of replacing the two-wire, 5-amp. meter with a two-wire, 10-amp. instrument received much favorable comment. The practice of outdoor metering was not recommended, for, although the errors due to extreme temperature variations are not large, proper maintenance and testing cannot be carried on in cold weather.

B. P. Romaine of the Weston Electrical Instrument Company presented an unusually interesting paper on indicating electrical measuring instruments for both direct and alternating currents, pointing out how inherent errors were compensated and accurate instruments thus assured.

A paper on "Experiments Relative to Compensating for Temperature Errors in Rotating Standards" was presented by R. H. Lydon of the Duncan Electric Manufacturing Company. The manner in which room and outdoor temperatures and the heat generated in the field coils and potential circuit affect the potential circuit, disk and permanent magnets was described.

INSTRUMENT TRANSFORMERS

Good practice in the application and maintenance of instrument transformers was the theme of C. McIntosh of the Buffalo General Electric Company. He said that in selecting a current transformer for a specific installation consideration should be given to the degree of accuracy required. Obviously, to operate an ammeter, a relay, a trip coil or similar instruments the phase-angle error may be neglected and even a considerable ratio error in the transformer may be permitted. But when a watt-hour meter is involved a good current transformer is necessary, for while ratio errors may be covered in meter calibration, phase-angle errors cannot be so compensated. The same argument, the speaker said, applies to potential transformers, where ratio error can be compensated in meter calibration but phase-angle error cannot, except by shifting the lag adjustment of the meters. Mr. McIntosh also described the various methods of testing current and potential transformers, pointing out the advantages and limitations of each.

E. E. Hill of the New York Edison Company gave an admirable paper on the testing and maintenance of relays in which staff requirements for this type of work were outlined and classification tests, including investigation, acceptance, installation and maintenance tests, were described.

E. A. LeFever of the Buffalo General Electric Company was re-elected chairman of the section, and C. L. Casler of the Syracuse Lighting Company was made vice-chairman.

Leading German Engineer Visits United States

THE portrait is that of Dr. George Klingenberg, an eminent German engineer and economist, past-president of the German Institute of Electrical Engineers and president of the German Institute of Mechanical Engineers, who is visiting this country for the purpose of studying superpower production and extra-high-tension transmission of electricity. Dr. Klingenberg will sail for home the latter part of April.

More Light and Power Company Reports for 1923

The Los Angeles Gas & Electric Corporation's annual report for 1923 shows the company's operating revenue from electric sales to have been $3,926,340, while the operating expenses of the electric division were $2,097,291, or a net operating revenue of $1,829,049. The net corporate income for the year was $2,149,010. The company declared dividends during the year amounting to $1,240,361, leaving an accumulated surplus at the end of the year of $2,295,583.

The Rochester Gas & Electric Corporation reports for 1923 gross income of $9,181,000 against $8,212,727 in 1922. After providing for interest and taxes, there remained a balance of $1,695,253 against $1,256,674.

The Kentucky Utilities Company for 1923 reports gross earnings of $2,935,679, comparing with $2,282,611 in 1922. Net available for dividends was $753,318 against $441,671 in 1922.

The Dayton Power & Light Company reports for 1923 operating revenues of $5,105,314, net operating earnings of $1,808,115, total income of $1,869,330, net income after deductions for interest, etc., of $744,642, and surplus for the year of $355,067. In 1922 gross earnings were $4,535,303 and net operating earnings $1,477,663.

The Wabash Valley Electric Company reports for 1923 a gross income of $284,521, net income of $140,145 and surplus of $54,306. Cost of plant and equipment at the end of the year was $2,447,383.

The Public Service Corporation of New Jersey, shows for 1923, in its fifteenth annual report, net income of subsidiaries of $5,345,875 after charges and taxes, compared with $5,570,239 in 1922. Total operating revenue of the subsidiary companies was $79,107,882 in 1923, compared with $78,356,962 in 1922.

Gregory Commission on Hydro Development at Chippawa

Among the general conclusions regarding the Queenston-Chippawa development of the Hydro-Electric Power Commission of Ontario which were drawn by the Gregory investigating commission, whose report was abstracted in last week's ELECTRICAL WORLD (page 590), were the following:

The work should have been done by a district construction department, the head of which should have been a man of high standing and wide experience in the work of construction, reporting directly to the commission.

The estimate submitted to the government in 1917 was unsound in many respects and should have been submitted to consulting engineers at the time it was made. If it had been submitted, the investigating commission has no doubt that the inadequacy would have been pointed out.

A serious mistake was made in overestimating the capacity of the shovels. This caused delays and the adoption of a rush schedule, which would not have been necessary under a proper management and which resulted in an unjustifiable excess cost of about $12,000,000.

The commission overspent the appropriations made by the Legislature and diverted funds which it had no authority to use for this purpose. The question of cost seems to have been lightly regarded.

The records of the proceedings of the commission were loosely kept. Many important steps that were taken and many decisions arrived at are not mentioned in the minutes.

Importation of Water Power from Canada Discussed

Referring to the proposed international development of Eastern Canadian water powers, Samuel Ferguson, president of the Hartford Electric Light Company, declared in a recent address that industries and utilities in the United States should not be obliged to pay in extra power costs the expense of waterway developments for the cheaper transportation of commodities from the West to the seaboard and to foreign ports. Such expense, he said, should be defrayed by toll charges on waterway use or by general taxation.

The speaker advocated continued vigorous improvement of generating plants and interconnections, pointing out that the later entrance of Canadian hydro-electric power will tie in with these facilities most advantageously. The field for interconnection is far from exhausted. At last year's peak-load period in the Boston-New York zone a total of 500,000 hp. in idle generating capacity existed among the generating plants of that region. Much of this would have been utilized with more complete tie-ins. Seven companies in this zone are now combining resources to bring power from Canada. The financial success of the enterprise depends in large measure upon the reliability of the transmission lines, which determines the need of reserve steam plant capacity in New England and New York and the feasibility of eliminating such reserves.

The estimated development cost of under $40 per horsepower at Lake St. John, 450 miles from Hartford, means that comparatively large losses could be incurred in some of the international transmission lines in preference to building reserve steam plants in the Northeast, assuming the requisite reliability of transmission. There is power enough in Canada to relieve the New England situation entirely, asserted Mr. Ferguson, but investors from the United States must be assured by the Canadian government that stated and agreed blocks of power can be developed and transmitted into this country for a long term of years before they will place their money in the enterprise.

National Electrical Credit Association's New Plan

At a recent meeting in New York of the board of managers of the National Electrical Credit Association E. W. Shepard, the president, submitted a report outlining recommendations designed to increase the usefulness of the association. These recommendations have been approved by the board and also by the directors of the three affiliated organizations which operate respectively in New York State, New England and the Middle and Southern Atlantic States. The Central and Pacific Coast divisions are expected to follow suit.

The president's plan covers five factors:

1. Organization. Two representatives from each local association are to be elected for two years during alternate years, so as to have men of experience always on the board.

2. Finances. Each local association will make up a budget early in December covering the coming year.

3. Services. Records showing the percentage of members using the forms will be kept, and studies of forms will be made periodically.

4. Publicity. At least one man is to be placed on the national board who is in direct contact with electrical trade papers.

5. Membership. A membership committee is to be organized in each association. Literature and lists of prospective members will be furnished and a prize offered to the member of each association who gets most members.

Colonel Kelly on Colorado Development

Chief Engineer of Federal Power Board Favors Immediate Production of 300,000 Kw.—Looks for Market for All Potential Power in Thirty Years

IN THE report on Colorado River development which Col. William Kelly, the chief engineer of the Federal Power Commission, submitted to the Secretary of the Interior in connection with the unanimous report made by the advisory committee of engineers and summarized in the ELECTRICAL WORLD last week, he makes the point that the information now at hand is not sufficient to justify the absolute selection of the site proposed by the Bureau of Reclamation for a dam in Boulder Canyon. It is his belief that with the expenditure of less than $100,000 it would be possible to put down enough holes to determine whether it will not be possible to get out of the narrow and inaccessible part of the canyon in the finding of a dam site. He believes the Mojave site is by far better than the one chosen by the Reclamation Bureau in Boulder Canyon. "If the Mojave site proves impracticable," says Colonel Kelly in his report, "further investigation of Black Canyon and Boulder Canyon should be made to determine the best location for the dam, taking into consideration the fact that it should provide only 4,000,000 acre-feet of flood storage and should be adjusted as to height to fit into the full scheme of development of the river without unnecessary loss of head."

Is is made clear in Colonel Kelly's report that it would be inadvisable for the federal government to undertake the development when private capital is ready and willing to do the work under the water-power act and accomplish all the purposes of flood control and irrigation which could be attained by a federal project. He points out specifically that "if the present controversies over the Colorado can be adjusted so as to permit the Federal Power Commission to act on applications now before it, the needed flood control and irrigation storage will be provided by power developments built without financial aid from the United States."

At another point in his report Colonel Kelly draws these conclusions:

"The final development of the river is almost certain to make Boulder Canyon a power development and not a storage reservoir. At that time the available water supply probably will put a limitation upon the amount of irrigation that can be developed. It is important for the ultimate development of irrigation that losses from evaporation in the river be kept at a minimum. If Boulder Canyon dam be built to the height recommended by the Bureau of Reclamation, evaporation losses in excess of those for dams of lesser height built to fit the ultimate development will amount to from 300,000 acre-feet to 450,000 acre-feet per year. Furthermore, the 605-ft. dam recommended will involve a loss of head in the canyon section of at least 80 ft., which represents an ultimate loss of 75,000 hp.

INITIAL DEVELOPMENT BY 1932

"A Colorado River development probably cannot be completed before 1930, but should be completed by 1932. The estimate of power-company engineers that a Colorado River development planned now should not exceed 300,000 kw. installed capacity appears sound. A larger development will be absorbed ultimately, but the risk of excessive carrying charges is not justifiable if the smaller development is feasible.

"Under present economic conditions power development is likely to go forward much more rapidly than irrigation. The power demand in southern California has increased in the past fourteen years at a rate of about 13 per cent compounded annually. There is a present mining load in Arizona carried by steam power that justifies the belief that 75,000 kw. to 80,000 kw. could be absorbed from the Colorado as soon as available, and development of power on the Colorado at Diamond Creek would now be under way but for lack of federal authority to use the public lands necessary. There are mining possibilities in Nevada and southern Utah that may create a large demand. They are too speculative at present to justify expenditure for power development, but may greatly accelerate power development once it is started. The mining load in the vicinity of Salt Lake City has grown so that development of the Flaming Gorge site on the Green River just below the Wyoming line is now under serious consideration by the Utah Light & Power Company.

"It is not extravagant to conclude that all the power in the canyon section of the Colorado may be absorbed in the next twenty-five or thirty years. While immediate expenditure should be limited to immediate needs, the possibility of such a demand for power is certainly great enough to justify taking it into account in planning development of the Colorado, to the extent of insuring the ultimate development of the greatest possible number of kilowatt-hours from

the canyon section commensurate with the higher uses of the water. This means that projects should be planned to use all available head, that storage for equalization of flow should be provided above the canyon section, and that storage for re-regulation of flow for irrigation in the lower basin should be provided at the bottom of the canyon section.

"Aside from the Flaming Gorge and Diamond Creek developments on the Colorado, any developments of power in the immediate future must look to southern California for a market, and the size of the development should be limited to what that market can absorb with certainty in order to keep the carrying charges at a minimum during the periods of construction and loading."

Electricity Helping to Fight the Boll Weevil

So far calcium arsenate has been proved to be one of the most effective means of poisoning the boll weevil, and spraying this poison in powder form from an airplane has been found a convenient means of placing it next to the offending bug. During these experiments it came out that particles of the chemical acquired positive electric charges from the air and thus were readily attracted by the negatively charged cotton plant, this attraction greatly increasing the efficiency of dusting operations. As a check on these findings, experiments were successfully made with dusting from the ground with calcium arsenate artificially electrified by a generator of proper polarity.

The Alabama Power Company has now turned over free of charge for a period of years to the Gulf States Chemical & Refining Company one of the steam plants it acquired last year at Montgomery, and this plant will be used for the manufacture of calcium arsenate according to an electrolytic process developed by one of the power company's engineers. Fifteen tons daily is expected to be the output at first, and 22 tons daily after the work gains momentum. The plant will be used also in other branches of agricultural chemistry. The Alabama Power Company is lending its plant as an evidence of its desire to help the Southern farmer. It has no pecuniary interest in the manufacture to be undertaken in its plant by the Gulf States company.

Revision of the Code for Electricity Meters

A revision of the Code for Electricity Meters, approved by the American Engineering Standards Committee in 1922 as "American standard," is now being arranged under the sponsorship of the Association of Edison Illuminating Companies, the Bureau of Standards and the National Electric Light Association. The sectional committee which will handle the revision numbers eighteen members, six of whom represent producers, five consumers and six general interests. One is an independent expert. The following trade and technical societies and groups are included in the organization of this sectional committee:

American Electric Railway Association—R. W. Eaton.
American Institute of Electrical Engineers—F. P. Cox and F. A. Kartak.
Association of Edison Illuminating Companies—O. J. Bushnell and F. V. Magalhaes.
Bureau of Standards—J. F. Meyer.
Electric Power Club—W. M. Bradshaw, F. Holmes, R. C. Lanphier G. A. Sawin, F. G. Vaughan.
Electrical Testing Laboratories—E. D. Doyle.
International Association of Municipal Electricians—A. L. Pierce.
National Electric Light Association—B. Currier and W. L. Wadsworth.
New York Public Service Commission—C. R. Vanneman.
Wisconsin Railroad Commission—C. B. Hayden.

The work includes: (a) Detail specifications for laboratory and acceptance tests of types, not only of watt-hour meters, but also of ampere-hour meters, demand meters, current limiters and current and voltage transformers; (b) analysis and summary of good practice for the installation of meters and auxiliaries; (c) definitions of units and technical terms relating to metering.

European Electrical Standards for 1923 Received

Copies of electrical engineering standards issued during 1923 by European standardizing bodies have been received by the American Engineering Standards Committee and can be furnished at a nominal charge, or the copies on file may be consulted at the office of that body. The standards received are:

Belgium—Belgian Standards Association: Requirements for armored cables, with impregnated paper insulation, for high voltages.

Czechoslovakia — Czechoslovakian Standards Society: Illustrated booklet regarding standardization.

Germany—Standards Committee of German Industry in co-operation with the Union of German Electrical Engineers: Standards for motors (voltage, nominal output, speed of rotation and efficiency); transformers (sizes, voltages and taps, terminal markings, rating and tolerances for various losses, dimensions of terminal fittings, etc.); meters (current strengths, windings, binding posts, terminal covers, meter covers, nameplate data, direction of rotation, insulation test, direction of rotating field, grounding, mounting of meters and connections); insulation (shanks for insulating handles and knobs, insulating handles, insulating knobs, insulators for high voltages, insulators with supporting brackets, straight insulator pins, swan-neck brackets with wood-screw thread).

Great Britain—British Engineering Standards Association: Control apparatus (definitions and data on sizes, ratings and duty cycles, nameplates and terminal markings, design and construction; insulation (nomenclature, sketches and tables for shapes and sizes); rating (definition, types of machine and of inclosure, service conditions, classes of rating, overloads, tests, etc.); wires and cables (eleven standards dealing with definitions, tests, specifications and packing).

Holland—General Committee for Standardization in the Netherlands: Cable accessories (sketches, tables of dimensions for various sizes, specifications for material, etc.).

Russia — Electrical standards and rules approved by the Central Electrical Soviet in Russia (standardization of mining machinery, transformer and switch oils, rules for inspection, magnet steel for permanent magnets and specifications for transformer and dynamo steel).

The Belgian, Dutch and Russian standards are available also in English translation.

Research Committee of the A. I. E. E. Hard at Work

Eight sub-committees of the research committee of the American Institute of Electrical Engineers are at work on different phases of research problems. These committees, with their chairmen, are designated thus: (1) Reviews and compendia of work already done, J. B. Whitehead; (2) nature of dielectric absorption, J. B. Whitehead; (3) phase difference in dielectrics, Delafield Du Bois; (4) electric strength, William A. Del Mar; (5) dielectric constant, T. S. Taylor; (6) resistivity, H. L. Curtis; (7) flashover voltage, F. W. Peek, Jr.; (8) theories, Vladimir Karapetoff.

The research committee also serves as an advisory committee on electrical engineering to the National Research Council, and it is in this relationship that the committee is devoting its chief efforts. A recent meeting was given over almost entirely to the work of the committee on electrical insulation of the Division of Engineering, National Research Council. The present outstanding question is as to how the plan for the work of the committee on electrical insulation, as published in the June number of the *Journal of the A. I. E. E.*, can best be furthered and hastened.

Volunteers for the work of the subcommittees, which requires not only care and time but a high type of electrical knowledge, have been obtained, and it is hoped that others will come in. The sub-committees plan to make a comprehensive review of all past work done in connection with the several topics. The ultimate plan of the committee is to collect and co-ordinate all of this information in an authoritative review of all past work in the field of insulation and to outline a plan for further experimental attack which will give best promise for a better fundamental knowledge of the phenomena involved in insulation processes.

The committee has rendered material assistance in obtaining a grant of money from the Heckscher Foundation for experimental work in the field of insulation under the direction of Professor Karapetoff of Cornell. The chairman of the committee, Dr. J. B. Whitehead, Johns Hopkins University, is also acting in an advisory capacity in several other lines of experimental work. The committee for the present, however, is withholding its efforts to promote individual experimental work pending the review of the literature outlined above.

International Management Congress at Prague

American engineering societies will unit with the Czechoslovak Society of Engineers and Architects in an international management congress under the auspices of the government of Czechoslovakia to be held in Prague in July, it is announced by the American Engineering Council. The Congress will follow the World Power Conference in London, which will be attended by engineers from practically every nation. The Prague invitation was transmitted by the Masaryk Academy to the engineering societies of this country through the American Engineering Council, of which Ex-Governor James S. Hartness of Vermont is president. Acceptances have been received from the four founder societies of civil, mining, mechanical and electrical engineers. Management problems in manufacturing and allied pursuits will be discussed.

The program embraces technique of organization and management, office organization, management control, labor relations elimination of waste, cost accounting as a factor in production and control, and motion and time studies. American and Czechoslovak engineers will deliver addresses. Delegates will attend from Poland, Jugoslavia, Bulgaria and other central European countries. Dr. B. Stepanek of New York, former Minister from Czechoslovakia to the United States, and Stan Spacek, engineer attaché of the Czechoslovak Legation at Washington, are aiding in the arrangements for the congress.

The Czechoslovak government has shown a keen interest in engineering development in the United States and has translated as an official document for general distribution among the industries the report of the Hoover committee on the elimination of waste in industry. The Prague congress will, it is expected, provided new opportunity to further international unity in the profession of engineering, toward which progress is being made, particularly in England, France, Italy and the United States.

The work of arranging a program of papers and the supervising of the American participation in the congress have been delegated by the invited societies to five organizations active in management.

Chicago A.I. and S.E.E. Hears About Plant Locomotives

Problems imposed upon electric locomotive manufacturers by industrial plants using narrow-gage railways were discussed at the March 14 meeting of the Chicago District, Association of Iron and Steel Electrical Engineers, by Frank E. Fisher, Goodman Manufacturing Company. A combination control circuit of series parallel and parallel was recommended as serving the steel industry the best. Mr. Fisher favored ball-bearing motors for electric locomotives and urged lubrication with clean grease. Although no standard industrial-locomotive voltage is in use at the present time, he declared that designers tried to limit the number of cells to a multiple of standard central-station service so as to avoid the purchase of extra charging equipment and also to obviate resistance losses in charging.

Gordon Fox pointed out the differences in electric locomotive haulages for coal mines and steel mills. In the mills entirely different conditions were met, due to shorter hauls and quicker stops, which imposed higher acceleration requirements.

Briefer News

Miami Beach Electric Company Changes Hands.—The American Power & Light Company of New York has acquired the Miami Beach (Fla.) Electric Company, including the light and power and street railway utilities, and contemplates expansion.

Merger of Ohio Edison and Springfield Companies Finally Effected.—The complete consolidation of the Ohio Edison Company and the Springfield Light, Heat & Power Company of Springfield, Ohio, which has been pending for several months, has been effected by the authorization of the Public Utilities Commission.

South Dakota Electric Companies Absorbed. — Electric light and power companies at Mitchell and Huron, S. D., have been purchased by the Northwestern Public Service Company, a Delaware corporation doing business in Nebraska, which is seeking authority to issue securities covering the purchases.

Eastern Wisconsin Electric Company to Make Its Headquarters at Fond du Lac.—Fond du Lac has been selected as the main headquarters and administrative center for all departments of the Eastern Wisconsin Electric Company, which has hitherto scattered its departments between Fond du Lac, Oshkosh and Sheboygan.

Doherty Takes Over Topeka Utility. —The Consumers' Light, Heat & Power Company of Topeka, Kan., is now a subsidiary of the Cities Service Company, according to an announcement made by Henry L. Doherty & Company. The Topeka company will be operated under the name of the Capital Gas & Electric Company and will serve 13,000 customers in a territory where the population is 50,000.

New England Section, S. P. E. E.— The spring meeting of this section of the Society for the Promotion of Engineering Education will be held at the Sheffield Scientific School, New Haven, on Saturday, April 5. In the afternoon Provost Henry S. Graves will address the gathering, and W. E. Wickenden will summarize the results of visits to Middle West institutions made in March as part of the program of the board of investigation and co-ordination.

Lake Shore Plant of Cleveland Electric Illuminating Company.—A new 30,000-kw. turbo-generator is almost ready for service at the Cleveland Electric Illuminating Company's Lake Shore plant, and a second 30,000-kw. unit is on order. With the 25,000-kw. unit installed last summer, these will represent an addition of 85,000 kw. to the company's generating capacity.

Revocable-Permit Law Fails to Pass in Oklahoma.—The Oklahoma State Legislature has adjourned without action on the law providing for surrender of municipal franchises by public utility companies, and for granting in lieu thereof revocable permits, and also providing for the issuance of certificates of necessity and convenience for establishing new public utility companies. This proposed law was in line with the resolution in favor of indeterminate permits passed by the Oklahoma Utilities Association at its recent meeting.

Erickson Beaten for Re-election. — Oliver T. Erickson, author of the Erickson bill in the interests of public ownership in the State of Washington, who has for some years been a councilman of Seattle, was defeated at the recent municipal election in that city by a large plurality. Mr. Erickson has been called "the father of municipal ownership" and has been several times re-elected to the City Council on that issue.

Franchise of St. Petersburg (Fla.) Central-Station Company Sustained.— The Florida Supreme Court, sitting at St. Petersburg, Fla., has quashed proceedings instituted to invalidate the franchise of the Pinellas County Power Company in that city. This company is controlled by A. E. Fitkin & Company, New York, and has met with opposition from the municipal government, which was forbidden by the courts last year to do a general electricity supply business in competition with the company. (See ELECTRICAL WORLD, November 24, 1923, page 1087.)

Kentucky Legislature Aids Dix River Dam. — Three bills were passed by the Kentucky Legislature at its recent session and signed by the Governor to rescind existing laws which would interfere with erection of the new dam of the Kentucky Hydro-Electric Company on the Dix River near Danville. One of these bills repealed an old law which held the river to be a navigable stream, and another killed a law regarding fish ladders. The third exempted dams erected for the purpose of generating electrical energy from penalties prescribed in certain existing statutes. The Dix River dam will be the first big hydro-electric development in Kentucky.

Merger of McKinley Companies Approved.—The Kansas Public Utilities Commission has approved the merger and reorganization plans of the various McKinley public service corporations in the state. The controlling stock in this merger will be held by the Topeka Railway & Light Company, which has taken over the Atchison Railway, Light & Power Company. The Wichita Railway,

Light & Power Company is the third company involved. Eventually the combined company will be called the Kansas Railway, Gas & Electric Company. Its assets are put at $15,000,000.

Commonwealth Edison's New Stock Issue. — The Commonwealth Edison Company last week sent official notice to its 34,250 stockholders of their privilege of subscription to additional stock at par—$100 per share—in the ratio of 20 per cent of their holdings as of April 1, 1924. The present outstanding stock of the Commonwealth Edison Company is $72,000,000. The additional stock to be issued amounts to $14,400,000. The proceeds will be used in the ordinary financing of additions to the company's properties to care for the constantly increasing business.

New York's Municipal Broadcasting Station.—The New York City authorities, who recently appropriated $50,000 for the installation of a municipal radio broadcasting station on top of the Municipal Building, have accepted the offer of the Westinghouse Electric International Company to supply the outfit, which will be one of the most powerful in the country. All is not yet clear sailing, however, since the New York Telephone & Telegraph Company has placed what the city government terms a "prohibitive price" on the installation of "remote-control service" by telephone wires. The city now talks of using its own telephone, police and fire lines to supply this service.

North Platte River Commission Meets in Washington.—The North Platte River Commission, recently appointed for the purpose of formulating a compact between the States of Colorado, Nebraska and Wyoming and the United States respecting the use and disposition of the waters of the North Platte River, was organized at Washington on March 20. Judge S. B. Davis of the Commerce Department is the commission's chairman, of which the other members are Delph E. Carpenter of Colorado, Robert H. Willis of Nebraska and S. G. Hopkins of Wyoming. Following a general discussion of the problems to be dealt with, the commission adjourned with the understanding that later meetings would be held in the West, when there would be public hearings at points in the states concerned.

Expect Skagit Power in Seattle by May 1.—In response to a request from the Seattle City Council for a report on the progress of the Skagit hydroelectric project, City Engineer J. D. Blackwell asserts that the power house is 97 per cent completed, the Gorge Creek tunnel 60 per cent lined and the transmission line 99 per cent finished. If work proceeds according to the present schedule, power from the Skagit will be available in Seattle on May 1, when all machinery and equipment will be ready for operation. The North substation will be completed by April 15, the report states. The tunnel, power house and transmission line are large enough for a 112,500-hp. plant.

Room Clause Eliminated in New Rates of Idaho Power Company.—The Public Utilities Commission of Idaho has rejected the rate schedules filed with it by the Idaho Power Company and has substituted new rates in the interest of equalization to the consumers of power and light. By the new rates approximately 15,000 of the 22,000 residence patrons of the company will pay lower rates. The schedule as filed by the company called for a minimum of $1 for the first 10 kw.-hr., 9 cents for the next 3 kw.-hr. per counted room, 7 cents for the next 3 kw.-hr. per counted room and 4 cents per kw.-hr., for the remainder. The commission eliminated the room clause entirely and set the rate as follows: $1 for the first 10 kw.-hr., 8 cents for the next 30 kw.-hr., 5 cents for the next 30 kw.-hr. and 4 cents for the remainder.

Value of Carrier-Current System Proved at Atlanta.—The value of the Western Electric carrier-current telephone system recently installed by the Georgia Railway & Power Company between its Boulevard substation at Atlanta and its Tallulah Falls plant, 89 miles away, was demonstrated a few days after its initial test when a severe sleet storm destroyed all ordinary telephone communication between the load dispatcher's office and the Tallulah Falls plant. The carrier system was brought into service and proved adequate for all purposes of load dispatching.

Oklahoma Power's Muskogee Station Starts Operation.—The new 22,500-kw. plant of the Oklahoma General Power Company 3 miles east of Muskogee was recently placed in operation. This station, which will be operated by the Oklahoma Gas & Electric Company, contains two General Electric turbo-generators, one of 15,000 kw. and the other of 7,500 kw. rating. Both turbines operate at 225 lb. steam pressure and 250 deg. superheat. Boiler-room equipment consists of six 1,022-hp. Edgemoor boilers, equipped with soot blowers and superheaters, which were designed to operate at 250 per cent overload. To provide for the fluctuating river levels the top of the building foundation was constructed 18 ft. above the high-water elevation of the river, while the floor of the intake and discharge tunnels is 60 ft. below the top of the building foundation. These intake and discharge tunnels are constructed of monolithic concrete and are 7½ ft. x 11 ft. Duplex drive is provided for the exciters for controlling heat balance. The boiler-feed pumps are steam-driven, and ash disposal is provided by using steel cars directly below the boilers. Three 13,200-volt, three-phase circuits carry service to Muskogee and Gibson. Two 63,000-volt circuits will connect this plant with the transmission system operated by the Oklahoma Gas & Electric Company.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations is published in the first issue of each volume. See January 5 issue, page 72, for latest list.]

Association of Iron and Steel Electrical Engineers — Fuel-saving conference, William Penn Hotel, Pittsburgh, April 2 and 3.

New England Section, S. P. E. E.—New Haven, April 5, Yale University.

American Institute of Electrical Engineers—Spring convention, Birmingham, Ala., April 7-11. F. L. Hutchinson, 33 West 39th St., New York.

American Society of Civil Engineers—Atlanta, April 9-12.

Middle West Division, N. E. L. A.—Kansas City, Mo., April 9-12. H. M. Davis, Bankers' Life Bldg., Lincoln, Neb.

Missouri Association of Public Utilities—Kansas City, April 10-12. F. D. Beardslee, 315 North 12th St., St. Louis.

Southeastern Water and Light Association—Piedmont Hotel, Atlanta, April 15-17. W. F. Steiglitz, Columbia, S. C.

Wisconsin Utilities Association—Hotel Pfister, Milwaukee, April 17-18. J. N. Cadby, 445 Washington Bldg., Madison.

Southwestern Division, N. E. L. A.—Hotel Grunewald, New Orleans, April 22-25. S. J. Ballinger, San Antonio, Tex.

Southwestern Public Service Association—New Orleans, April 22-25. E. N. Willis, Dallas, Tex.

American Electrochemical Society—Hotel Bellevue-Stratford, Philadelphia, April 24-26. C. G. Fink, Columbia University, New York.

American Physical Society—Washington, April 25-26.

Rocky Mountain Division, N. E. L. A.—Cheyenne, Wyo., May 5-6. O. A. Weller, 900 15th St., Denver.

Wyoming Utilities Association—Cheyenne, May 5-6. H. C. Chappell, Casper, Wyo.

Nebraska Section, N. E. L. A.—Omaha, May 8-9. H. M. Davis, Bankers' Life Bldg., Lincoln.

Pacific Coast Electrical Association—Hotel del Coronado, San Diego, Cal., May 17-20.

National Electric Light Association—Atlantic City, N. J., May 19-23. M. H. Aylesworth, 29 West 39th St., New York.

National Electrical Credit Association—Chicago, May 22-23. F. P. Vose, 1347 Marquette Bldg., Chicago.

Electric Power Club — Seaview Golf Club, Absecon, N. J., May 26-29. S. N. Clarkson, B. F. Keith Bldg., Cleveland.

Electrical Supply Jobbers' Association—Homestead Hotel, Hot Springs, Va., June 4-6. Franklin Overbagh, 411 South Clinton Street, Chicago.

Pacific Coast Electrical Association—Hotel Coronado, Coronado, Cal., June 17-20. S. H. Taylor, 527 Rialto Bldg., San Francisco.

American Institute of Electrical Engineers — Annual convention, Edgewater Beach (Chicago), June 23-27. F. L. Hutchinson, 33 West 39th St., New York.

Associated Manufacturers of Electrical Supplies—Hotel Ambassador, Atlantic City, N. J., June 24-27.

Society for the Promotion of Engineering Education—University of Colorado, Boulder, Col., June 25-26. F. L. Bishop, University of Pittsburgh, Pittsburgh.

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

J. V. Wall, formerly connected with the power department of the Monongahela-West Penn Public Service Company, Fairmont, W. Va., is now associated with Stone & Webster in the designing division at Boston, Mass.

William B. McKinley was re-elected chairman of the board and **Clement Studebaker, Jr.,** president at the first annual meeting of stockholders of the Illinois Power & Light Corporation, Chicago. The entire roster of officers chosen when the company was organized in July, 1923, was re-elected.

D. L. Jasinsky has been made engineer in charge of the new Waukegan station of the Public Service Company of Northern Illinois. Beginning his connection with the company at Blue Island in 1912, Mr. Jasinsky was appointed assistant engineer in charge of that plant four years later and held that place up to the time of his recent transfer.

E. S. Stickle has recently been appointed vice-president of the Delta-Star Electric Company, Chicago. Mr. Stickle has for several years had charge of the Pittsburgh district of the company, over which he will retain supervision in addition to his new duties. He has been actively identified with the electrical business for the past twenty-two years.

E. B. Moore, who had been general manager of the Monongahela-West Penn Public Service Company, Fairmont, W. Va., and its predecessor, the Monongahela Power & Railway Company, for a number of years, recently resigned. Mr. Moore has established residence in Greensburg, Pa., where large private interests demand his entire attention.

Prof. George Klingenberg, head of the Technical High School in Berlin and director of the General Electric Company in Germany, arrived in New York on Sunday, March 23, on board the liner *Ballin,* to make a study of American power transmission methods. Professor Klingenberg is planning to visit most of the large power plants in the East. He is a native of Hamburg and was graduated from the Berlin-Charlottenburg technical school, where later through his lectures on power station design he soon gained fame. It was in 1902 that Professor Klingenberg became identified with the General Electric Company as director in charge of the power-station department, continuing, however, his lectures at the university. Dr. Klingenberg's achievements have received wide recognition in German technical and engineering circles and by the German government, which appointed him to the board of supervisors of the Physical-Technical Institute (Physikalisch - Technische Reichsanstalt). In 1919 he was awarded the honorary degree of doctor of engineering by the Charlottenburg Hochschule. He is a past-president of the German Institute of Electrical Engineers (Verband deutscher Elektrotechniker), president of the German Association of Mechanical Engineers (Verein deutscher Ingenieure), a prolific inventor and writer of books on power-station design.

A. B. Day General Manager in Los Angeles

A. B. Day, general superintendent of the Los Angeles Gas & Electric Corporation, was recently elected to the position of vice-president and general manager of the company, succeeding William Baurhyte, who was elected president in place of W. B. Cline.

A. B. DAY

Beginning as salesman in the gas-stove department thirty years ago, immediately after his graduation from the Los Angeles high school, and later becoming keeper of the consumers' ledger, Mr. Day soon was performing the duties of chief clerk of the electric office and subsequently those of manager of the gas-appliance department. About twelve years ago he was promoted to the position of assistant to the vice-president. Later, after being made auditor, he served successively as assistant secretary, manager of operations and as assistant general superintendent. In 1921 Mr. Day became general superintendent.

J. Allen Johnson has become identified with the engineering firm of Harper & Taylor, Inc., in the capacity of electrical engineer. Mr. Johnson has been electrical engineer of the Niagara Falls Power Company since 1918, and for fifteen years prior to that connection he was associated with the Ontario Power Company in the same capacity. While occupying these positions he has developed many improvements in electrical equipment and design for central-station and transmission practice.

E. G. Russell, formerly connected with the testing department of the Commonwealth Edison Company, Chicago, is now associated with the testing department of the Bureau of Power and Light at Los Angeles.

Fountain C. Beattie has recently been made chief engineer of the Lowellville (Ohio) power station of the Pennsylvania-Ohio Power & Light Company. Mr. Beattie spent more than five years in the service of the Old Dominion Power Company at Norton, Va., as chief engineer and general superintendent before affiliating himself with the Penn-Ohio system at Lowellville. He is a Virginian by birth and a graduate of the Bliss Electrical School in Washington, D. C. Following his graduation in 1898 he became turbine erector for the Westinghouse Electric & Manufacturing Company and subsequently was employed by the Pennsylvania Railroad at the Long Island City electric plant. After spending several years in South America Mr. Beattie returned to the United States and joined the Old Dominion Power Company at Norton.

Obituary

Nicholas J. Hullin, for several years superintendent of construction for the Pacific Gas & Electric Company at Sacramento, Cal., died in that city on February 25. Mr. Hullin had been ill several months.

Leon H. Mixer, chief engineer of the Valdosta (Ga.) Lighting Company, died recently after an illness of ten days which proved to be hydrophobia. Mr. Mixer had been identified with the Valdosta company, which is a Day & Zimmermann property, for the past twelve years in the capacity of chief engineer.

Sidney L. E. Rose, for fifteen years an engineer in the illuminating engineering laboratory of the General Electric Company at Schenectady, died March 17 in St. Louis. Mr. Rose was graduated from Queens University in Ontario in 1903 and in 1905 joined the General Electric laboratory at Lynn. Two years later he was transferred to the illuminating engineering department, which was moved to Schenectady in 1909. Mr. Rose was forty-seven years of age.

Theodore W. Passailaigue, vice-president of the Charleston (S. C.) Consolidated Railway & Lighting Company recently died. Mr. Passailaigue was identified with the Enterprise Railway, a horse-car line, when the Consolidated interests absorbed it and instituted an electric railway system. He was elected vice-president of the Charleston Consolidated Railway, Gas & Electric Company in 1917 and vice-president of the Charleston Consolidated Railway & Lighting Company, which is the operating company, in 1922. Mr. Passailaigue was about sixty-three years of age.

Commission Rulings

Charging Off Abandoned Property.—Abandoned property acquired by an electric utility as the result of a merger but not used in public service should not be charged off against the depreciation reserve but should be amortized over a period of years, according to a decision of the New York Public Service Commission concerning the People's Gas & Electric Company of Oswego. The commission said: "The reserve for accrued amortization of capital has been built up through charges to consumers from the revenues derived from rates based on property actually operated. The amount deducted from the reserve for this abandoned property cannot be permitted."

Change of Municipal Schedules Predicated on Increase of Capacity.—Block rate schedules were substituted by the Wisconsin Railroad Commission for active load schedules in the case of the municipal electric plant of Evansville, Wis., which had changed from a plant of limited capacity to a plant having a capacity practically unlimited by reason of connection with a transmission line. A rural electric charge should be assessed, the commission said, to cover transformer-core losses and excess cost of reading meters and handling accounts where rural customers agree to pay for the entire cost of the line, transformers and meters, all maintenance thereof and all replacements. No rural charge was made, however, in the case of consumers who were furnished service from the city's secondaries and from a transformer supplying urban customers on the opposite side of the street.

Stipulations Regarding Rural Service in Wisconsin. — Allowing to the Greenwood-Loyal Joint Transmission Line 4 per cent per annum upon the cost new of its rural lines, although the investment had been made by consumers, the Wisconsin Railroad Commission made a number of rulings concerning such lines, the more important being to the following effect: A rural rate developed in a territory served by two municipal plants and a joint transmission line owned by the municipalities should be of such a character as to be applicable to all customers served by the utilities concerned upon a common basis, although the charges may vary according to conditions on the various lines. New consumers may be required to pay a connection charge equal to their share of the construction cost of rural lines financed by the original consumers, and when new line construction is necessary to reach a consumer the cost of such construction should be applied against the connection charge and the difference, if any, divided between all consumers. In the event that the cost of the additional construction exceeds the connection charge, the consumer connected should pay, in addition to the regular connection charge, an amount equal to the difference between the connection charge and the cost of the construction. A public utility should furnish all necessary metering equipment for consumers, and in existing cases where the ownership of meters lies with the consumers the utility should take the necessary steps to acquire them, reimbursing the consumers for their investments, the amount paid by the utility being based upon the number of years of meter service. A rate for rural electric service should meet all the costs of supplying rural consumers with energy, since this class of service should not have a part of its cost carried by other classes of service where different conditions prevail.

Recent Court Decisions

Power Company May Cut Fences Across Right-of-Way, but Must Restore Them Promptly.—In Jewell vs. Wisconsin-Minnesota Light & Power Company the Wisconsin Supreme Court held, in condemnation proceedings, that a light and power company possessing a right-of-way over land, has the right, in order to maintain its lines and make repairs, to cut or remove fences across the right-of-way, but is required to restore them within a reasonable time or respond in damages for failure to do so. (194 N. W. 31.)*

No Constitutional Principles Governing Valuation.—The Wisconsin Supreme Court, although setting aside an order affecting the Chippewa Falls gas rates of the Wisconsin-Minnesota Light & Power Company as confiscatory, took occasion to say: "The constitutional rights of a utility are not invaded by the pursuit of a wrong method of valuation. In the absence of a method prescribed by the statute, the commission may proceed as it pleases. It is not its method that is to be reviewed, but the result reached by the commission. The statute charges the commission with the duty of ascertaining and declaring a reasonable rate. If that is done, the method by which the commission arrives at the result is not subject to criticism. If, however, the rate prescribed by the commission is not confiscatory, the constitutional rights of the utility are invaded and it is the duty of the court to give relief. . . . We know of no constitutional principles of valuation. It is not so long ago that the utilities were before the courts contending with great earnestness that investment cost was the proper method of valuation and the public authorities were claiming with equal earnestness and candor that cost of reproduction new less depreciation was the proper basis. The situation is now exactly reversed. Both views have been approved in greater or less degree by the courts where constitutional rights of parties are involved. In that situation we do not see how it can be said that there is such a thing as constitutional principles of valuation. The ascertainment of present fair value 'is not a matter of formulas, but there must be a reasonable judgment having its basis on a proper consideration of all relevant facts.'"

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

New York Commission Has No Jurisdiction Over Exchange of Stock. — A suit brought by the People against the Liberty Light & Power Company to impose a penalty for the company's failure to get the Public Service Commission's approval of the exchange of all its outstanding stock for no-par-value stock was dismissed by the New York Supreme Court, which held that the power involved was not conferred on the commission by statute and could not be by implication, nothing affecting the corporation's integrity being involved in changing the character of its stock when the actual existing capital was unaffected. (201 N. Y. S. 302.)

Duty of Commission After Court Reverses Rate Order.—The Ohio Supreme Court decreed in an action brought by the Cincinnati & Suburban Bell Telephone Company against the Public Utilities Commission of Ohio that the commission must fix and determine a just and reasonable rate after a former rate order has been reversed by the court and the cause remanded generally for further proceedings according to law. The re-establishment of the rates in effect before the former order, upon the theory that that rate became the legal rate automatically, is not sufficient, the court declared. (140 N. E. 86.)

Power Company Held Responsible for Wreck of Steamboat Through Giving Way of Dam Gates.—An unusual issue was presented in Winans vs. Northern States Power Company. The plaintiff owned a steamboat which, he asserted, was wrecked because an ice jam in the Mississippi tore out eight gates in the defendant company's power dam near Coon Creek before they could be raised, the rising waters carrying the boat, which was securely moored, 12 ft. or 15 ft. from its position and leaving it so suspended between the shore and a submerged pile of concrete that it broke in two. The company denied these alleged facts and said the boat was wrecked by a gale of wind. The Supreme Court of Minnesota held (1) that the gates in a dam are a structural part thereof and the jury was warranted in drawing the same inference of negligence from their failure as if a portion of the dam itself had given way; (2) that the doctrine of *res ipsa loquitur* ("the thing speaks for itself") was rightly held applicable; (3) that the right of the public to use a navigable stream includes the right of moorage; (4) that the question of sole proximate cause of the wreck was for the jury's determination; (5) that the damages ($4,600) were not so excessive as to call for the upsetting of the verdict, which was accordingly affirmed. (196 N. W. 811.)

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

Buying Tape on Specifications

To Replace "Price Competition" by "Quality Competition"—The Purchaser Is the Court of Last Resort and His Co-operation Is Necessary

By Walter H. Bieringer

Sales Manager Tape Department, Plymouth Rubber Company, Canton, Mass.

WITHIN the last few years the number of rubber firms and corporations which manufacture friction tape and compounds has more than doubled. This is true in general not only in the United States and Canada but also in Europe. The demand for electrical tapes is steadily increasing and the reasons for this are many. Among the most important factors are the extensive production of radio sets, recent inventions in electrical machinery and apparatus, the growth of the telephone and telegraph industry, the development of automobile manufacturing and the constant replacement of other forms of energy by electricity. The outlook for the tape industry during 1924 should be even better than during the war boom, the program for this year being crowded with plans for huge construction in all forms of building.

This all sounds encouraging, but unfortunately there is a serious problem to consider as the demand for tape increases, and that is the question of purchasing on a quality basis, with the aid of specifications. Many manufacturers and railroads have learned through bitter experience that purchasing the lowest-priced tape is an extremely expensive habit. A single bad joint has ruined the best wiring system and has entirely nullified the value of high-grade insulation.

What Makes Tape Good

A. W. Stringham of the Mitchell-Rand Manufacturing Company, in a recent booklet on friction tape, declares the most important factors in determining tape quality to be (1) adhesiveness, (2) lowest pinhole count per yard, (3) insulation or dielectric resistance, (4) tensile strength of fabric, (5) life of the compound. He states that adhesiveness is important because it insures uniform contact of every lap, thus excluding moisture; dielectric resistance means enduring insulation; tensile strength permits tight wraps or neater work without breaks and consequent waste of material and time, and compound that dries out quickly renders tape useless and thus increases its ultimate cost.

There are laboratories in every large city that would be glad to test tape for a very nominal sum. This is practically the only resort for the jobber, who seldom has any testing equipment and who would do well to have periodic comparative tests of tape run off and reported upon. The average buyer, however, does not possess adequate facilities for testing these essential points. If the tape is sticky and the price low, it usually meets with the purchaser's indifferent approval on the old but now exploded theory that "Tape is tape." Excessive stickiness usually means poor adhesive qualities, but many buyers refuse to look at a drier compound.

Different consumers specify different tensions and various rates of unwinding in practice. The object of these tests is to measure the security of a newly wrapped electrical splice. Peculiarly enough, some of the tapes which possess an extra-strong friction test defeat their object in that they age very poorly; that is, they dry out quicker and lose their "tacky" qualities. Tackiness or the ease with which tape sticks to itself or to other objects is fully as important as and frequently more important than the strength of adhesion. It must be borne in mind that some of the highest-priced tapes possess high friction tests and yet are inferior to cheaper tapes, which, owing to their increased tackiness in particular cases, form a tighter and more lasting joint.

Most of our large railroads have already been educated to purchase tapes guaranteed to meet certain definite specifications, and it is well known that the United States Navy has long demanded a particular quality. There are also a few large manufacturers who have already fallen into line by specifying exactly the tests which their tape and splicing compound must pass for acceptance.

An example of a railroad specification for this quality may be quoted, although it should be remembered that the specification is rather arbitrary and does not tell the whole story. It is worth while citing this example, however, in emphasizing the general value of buying on specification:

Representative Specifications

Adhesiveness.—This is usually measured by friction tests. The adhesion between adjacent layers of the tape shall be such that when a strip of tape 2 ft. long is taken from a roll and wound upon a mandrel 1 in. in diameter under a tension of 10 lb. per inch of width at a rate of 30 in. per minute, a weight of 4 lb. per inch of width shall not cause the plies to separate at a rate greater than 30 in. per minute.

The test shall be made at a room temperature not lower than 18 deg. C. (64.4 deg. F.) nor higher than 32 deg. C. (90 deg. F.), and the sample shall have been kept within these temperature limits thirty minutes previous to the time of testing.

Pin Holes.—The usual restriction on pin holes is that a 3-yd. length of ¾-in. tape should not contain more than a total of six pin holes, and there should not be more than three of these in any one yard. The ideal tape would contain no pinholes. Practical manufacturing difficulties make it necessary to permit a reasonable minimum. Each pinhole is a possible source of electrical leakage and, under moist conditions, even of short circuits. However, if the pinholes are but few and far between, an occasional pinhole is covered by the other layers of tape. With too many pinholes there is a probability that this covering will be imperfect; that is, one pinhole may be superposed upon another. In this way tiny pass-

ages may be formed through the tape joints, resulting in imperfect insulation.

Dielectric Strength.—This is the voltage necessary to overcome the insulating properties of a substance as determined under its definite conditions. With ¾-in. friction tape the usual test calls for subjecting a single thickness of tape to an alternating-current voltage of 1,000 at 60 cycles per second for a period of five minutes. Now friction tape itself is not intended to be used directly for voltages as high as this, but this test is made with the voltage intentionally exaggerated so as to be sure that the tape will stand up under ordinary conditions.

Tensile Strength.—The usual requirement calls for a tensile strength of 40 lb. per inch width of tape, or 30 lb. for the usual ¾-in. width. The object of this test is primarily twofold—(1) to show that a cotton sheeting of the proper quality has been used as a base; (2) to show that the tape is strong enough to permit of the proper tension which must be used in making thoroughly insulated joints. A tape which is too weak and perishable under 30 lb. strength test for the ¾-in. width will break while the tape is being applied.

Life.—The life of the tape, in the ordinary use of the term, does not apply to the condition of the tape in the finished joint, but rather to the serviceability of the tape after it is aged. Its prime importance is measured by depreciation of stocks of tape on hand. The object is economic rather than electrical. However, poorly aging tapes, even of the most expensive brands, may lead to poorly insulated joints, because a dried-out tape does not possess the necessary tackiness. A good tape which is kept wrapped in tinfoil and protected from very excessive temperature changes and light should be still serviceable one year after its date of manufacture.

European buyers are more prone to insist on specification tapes than are Americans. The United States, however, leads the world in the manufacture of tapes and compound, and incidentally the export business will be excellent this year provided that the rates of exchange become more stabilized.

The customer is, in the last analysis, the manufacturer's "boss," and it will be through the former's co-operation that the tape problem will be solved satisfactorily. Specification buying and local testing will help to convince the market of the necessity for using the highest grade of tapes, taking all qualities and conditions into consideration, and a spread of 1 cent a pound is not a large one to pay for quality material. The recent disturbed conditions in the textile industry have had no great effect on the tape industry, and the stage is set for real progress in the satisfactory buying and use of this class of products, given discrimination in purchasing.

Handicaps to Consultation Service

Requests for Rush Work with Insufficient Instructions or Hampering Restrictions Prevent Most Effective Aid and Increase Unit Cost of Equipment

By L. C. Hart
President Hi-Voltage Equipment Company, Cleveland, Ohio

VIRTUALLY every consulting engineer has at some time or other complained that the giving of free advice by manufacturers to prospective buyers of equipment is unfair competition, and some manufacturers bemoan the fact that they have been forced to give consulting advice gratis; but I for one believe that manufacturers will have to continue this practice and in so doing will be in no worse position than if the advisory service were left entirely to consulting engineers. At least three reasons seem to justify this belief, in my opinion: (1) Many purchasers of electrical equipment cannot afford to engage a consulting engineer, but none the less need advice to install the apparatus properly; (2) manufacturers are in the best position to know how their own equipment can be utilized most effectively; (3) if manufacturers were to refuse advice to customers, consulting engineers would draw upon them for suggestions as frequently as buyers do at present, hence manufacturers would not be relieved of the consulting service by giving up their present practice and would profit less than at present.

Indefinite Requirements

In connection with this so-called "free consulting advice," however, there is one practice which many buyers are following that not only handicaps the manufacturer but also the person who seeks the information. It is the unnecessary delay in asking for bids, combined with the imposition of hampering restrictions or the absence of sufficient information on which to base the bids. In the business in which I am engaged this practice seems to be more pronounced in connection with outdoor switching and transformer substations used with steel-tower lines than with those used with wooden-pole lines. Probably the reason is that the power lines, because of their importance, demand greater engineering attention and the switching stations and substations come in as an afterthought, so that insufficient time is afforded for considering specifically the requirements on which the bids should be made. Wooden-pole lines possibly require less attention in engineering departments, so that the switching and transformer stations may receive attention early enough to permit supplying the manufacturer with definite instructions concerning them when requests are made for bids.

The unfortunate part of this practice is that the manufacturers, without any assurance of obtaining the business, must throw their entire engineering force onto a rush job, possibly to find out later that the prospective purchaser is desirous of changing the major requirements because these did not have sufficient consideration in the beginning. The buyer evidently fails to recognize that the cost of rendering this so-called "free consulting service" must be spread over the cost of the equipment sold, since the work cannot be done for nothing. Hence any unnecessary work which the prospective buyer puts on the manufacturer will raise the cost of the equipment purchased. But if the purchaser would give more definite requirements and submit the information sufficiently in advance of the time when bids must be submitted, it would enable the manufacturer to spread out the work over a longer period of time, thereby avoiding peak loads on his engineering department, and would also enable him to do a better job.

Unnecessary Restrictions

Contrasted with the purchaser who does not give sufficient information is the purchaser who dictates so many conditions that the manufacturer is forced to develop a special kind of construction to which his equipment must be adapted. The folly of this practice is that the high-voltage equipment must do the work and hence should be installed under most favorable conditions, whereas the structure which supports or houses the equipment is of relatively secondary importance. The result is much like that which is brought about when a person specifies the exact layout and arrangement of rooms for a home and then requires an architect to make a building from these specifications which will not only be economical in price but

esthetic within and without. When this practice is followed the home builder will usually find that the architect is forced to use overhanging partitions which increase the floor-strength requirements, or the owner may require the building of a fireplace in an impossible position. If the home in which a person is to live and about which he should know more than about anything else cannot be specified in detail by him, it should be easy to realize that even the user of electrical equipment may impose unreasonable limitations on its manufacturer if too many details are specified.

Though it is fully recognized that the buyer of equipment often has a fund of experience regarding the conditions under which the apparatus which he contemplates purchasing will work, he should recognize that the progressive manufacturer acquaints himself with all of these operating conditions and has a perspective of everybody's experience which the individual buyer may not have. Instead of a buyer specifying how the equipment should be installed under certain operating conditions, it would be much better if he would outline these operating conditions to the manufacturer and allow the latter some leeway in adapting his apparatus to them.

WHAT DATA ARE NEEDED

The foregoing handicaps to the best consulting service from manufacturers would be eliminated if more time were allowed manufacturers in which to study methods of meeting the prospective customers' requirements and if the prospective purchaser would supply a one-line diagram of the switching connections desired and give the primary and secondary voltages, space available for installation, direction of incoming and outgoing circuits, minimum height of same, possible future additions and special requirements.

Some attempt has been made to induce engineers to give more consideration to the data desired by briefly stating them in catalogs, and where requests for bids are made without supplying the information its necessity is reiterated in a letter. Although this method serves to correct faulty practices in individual cases, its benefit to prospective buyers is not generally recognized. All manufacturers have undoubtedly experienced the troubles recounted, and all would benefit mutually with their customers if the messages indicated were disseminated in their trade literature, sales contact and correspondence, and if the receipt of incomplete instructions were followed up by a blank form requesting this information which is so essential to rendering the best service in the least time and at the least cost.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

THE well-defined lull in electrical business continues almost uniformly throughout the country. According to general opinion, it is largely the product of the present uncertain conditions in Washington and their natural reflection in the stock market. In spite of this, however, confidence and optimism prevail. Some manufacturers have curtailed production somewhat, in tune with the falling off in business. This is not taken as an unhealthy or unpromising sign, however, because stocks are not large and the increased demand which inevitably will come with the opening of spring will immediately react to create a stronger general market.

Opinion has been prominently expressed that the bulk of the central-station buying of heavy apparatus is over for the time being, the major demand from this field at the moment being for secondary equipment. A number of important inquiries, distributed throughout the country, have developed within the week, however, promising some large orders for major apparatus.

Appliance selling continues strong in New England; in addition, there is active buying of pole-line material, and sales in general are holding up fairly well. In the New York district, too, pole-line hardware has been moving exceptionally well, a notable demand coming from three of the largest railroads, which are purchasing in connection with automatic train control. Bad weather has slowed up business in the Southeast, but several successful large appliance campaigns are in active operation.

In the Middle West the industrial heating field has provided the foremost orders of the week. Prices are unsteady on the Pacific Coast, and general conditions have been somewhat disturbed by local anxiety over the water shortage and the epidemic in the cattle industry. Credit and collection conditions there are reported materially improved.

Linemen's Tool Demand Good—Heavier Construction Trend

WITH the construction of larger transmission lines each year, the demand for heavier and sturdier linemen's tools keeps increasing. Power companies which are using aluminum-reinforced steel cable and large-conductor copper cable are demanding large-size grips weighing 11 lb. and sleeve twisters, for which two years ago there was no possible demand. A similar advance has been made in the telephone and telegraph industry, where machine-switching equipment now requires specially constructed pliers which serve as a handy die to repair certain portions of the rotating apparatus.

These demands, together with a regular volume of business from other utilities constructing standard-size transmission lines, are responsible for the increased business in 1923, amounting to 20 per cent over 1922 as reported by one manufacturer. The outlook for 1924 appears to be equally good, and some increases are looked for.

The surplus of government stocks left over from the war appears now to have been practically all absorbed, so that the tool and construction equipment market is no longer unstabilized by this factor. Shipments of standard equipment—pliers, belts, climbers, twisters, etc.—are made directly from stock, since manufacturers have no trouble from either the standpoint of manufacturing facilities or from shortage of raw materials or labor. Price levels have remained fairly constant with only a few minor changes since March, 1922, and no immediate price change is contemplated.

A change in the method of purchasing linemen's equipment has been noted during the past two years. Most power and telephone and telegraph companies now buy their own equipment and distribute it among their men. The old policy of having the lineman purchase his own equipment led to many fatalities because the operating companies had no direct jurisdiction over the equipment used. As it is now, they can condemn any hazardous equipment without creating bad feeling on the part of the linemen.

Comparison of Radio with Other Industries Shows Rapid Growth

THE importance that the radio industry has attained in the past few years is very interestingly shown by the following two quotations from recent addresses:

David Sarnoff, vice-president and general manager Radio Corporation of America, quoting statistics on the size of the present radio business, stated that there are 563 licensed broadcasting stations in the United States, 3,000,000 radio receiving sets in use in this country, 10,000,000 listeners, 250,000 persons directly or indirectly connected with the industry, 3,000 manufacturers of radio supplies, 1,000 wholesale distributors and jobbers, 20,000 retail dealers, 1,000 newspapers and 2,500 country weeklies which carry radio

programs and radio news columns, thirty exclusively radio periodicals, fifty magazines with radio sections, 250 popular and technical books written on radio and seven exclusively radio trade papers, and estimated expenditures by the American public during 1923 for radio material of all description and make totaled $150,000,000.

Roger W. Babson, economist, in comparing the radio industry with many of the important long-established industries, says: "On the basis of figures for 1923 it is probable that the American people will spend approximately $350,000,000 for radio equipment during the present year. A conservative estimate of the business in vacuum tubes alone is about $50,000,000. Available figures on sporting goods, cameras, etc., show a value of about $185,000,000 annually. The value of the radio business is nearly twice as great as that of the carpet and rug business. For every dollar spent on furniture 33 cents is spent on radio. For every dollar spent on boots and shoes 25 cents is spent on radio. For every dollar spent for musical instruments of all kinds 75 cents is spent for radio. The value of radio business is nearly three-fourths of the jewelry business as a whole."

These figures emphasize the growing importance of the radio industry, which is passing rapidly from the status of a fad to that of a staple and taking a prominent place among the important industries of the country. At present there is a strong demand for all radio material, with the demand for vacuum tubes exceeding the supply.

Pole-Line Hardware in Strong Demand in New York District

POLE-LINE hardware has been selling actively in the New York district this week, all the material being ordered for new construction. The usual demand for maintenance work in the early spring is expected to be at least the same as last year—all of which follows a winter of consistent demand. Much pole-line material has been purchased lately by three of the largest railroads to be used for signal construction work in connection with the recent ruling of the Interstate Commerce Commission calling for the installation of an automatic train-control system.

There has been no let-up of the activity of the utility companies, and none is foreseen for some time. Active negotiations, well distributed throughout the country, are still in progress for major apparatus. All auxiliary central-station lines such as transformers, meters, etc., are moving very fast, the demand having a tendency to lengthen deliveries.

In the jobbing industry business is quiet, the sale of radio having fallen off gradually within the last two weeks. This, however, is considered as entirely seasonal. Blower and exhaust-fan business is exceptionally good. Stocks are in excellent shape and perhaps more normal than they have been for many years. One jobber reports an unusual demand for sockets by the fixture manufacturers. Collections are good and are continuing to show improvement.

Quiet Confidence Pervades Trade in New England District

ELECTRICAL material sales in New England are holding up fairly well despite evidences of caution among buyers. The demand for wiring supplies is a little quieter pending spring development of building activities. After a fortnight of decreased business in fixtures the demand has again picked up. Stocks are large, however, and there is not a little shading of prices under close competition.

Central-station buying of pole-line material is fairly active. Occasional sales of large motors are reported, and in the main units of 10 hp. and under are moving better, but motor sales are probably 15 per cent under those of a year ago. Appliance business is developing remarkably well except in communities where part-time industry operation is hampering sales.

Collections are arousing little anxiety, though still slower than a few weeks ago, and credits are being very carefully watched. Deliveries are excellent, except for a shortage in locust pins and some radio material.

Industrial Heating Prominent in Chicago Buying

ELECTRIC industrial heating sales in the Chicago district to date this year are approximately 100 per cent greater than last year, and the outlook for the month of March is very promising. The demand for hotel and restaurant equipment is especially good.

Heavy demand for wire was also noticeable last week. Jobbers were requested to quote on several large individual requirements of a special nature, and competition was extremely keen. The price of loom advanced one point, and various manufacturers report booking orders for considerable quantities of this material. Pole-line hardware demand also increased somewhat. The principal outstanding feature of the appliance business is the remarkable sales of individual ice machines. One installation alone was for twenty-eight of these machines, while several large installations are being figured upon at the present time. Orders for equipping a million-volt testing laboratory have been placed by one of the large central-station companies in this territory.

On the other lines business was a little quiet, although the volume was satisfactory. Building activity continues, and with the present favorable weather, trade conditions should revive materially.

Bad Weather in the Southeast District Retards Activities

CONTINUED bad weather is having a depressing effect throughout the Southeast district and is tending somewhat to slow down activities in practically all lines. A great deal of building construction is accordingly behind schedule. However, sales campaigns in North Carolina and Florida have boosted electric washing machines to such a degree that similar campaigns are starting in various sections of other Southeastern states and the general feeling is that of optimism.

The movement of electric drills has been accelerated by building construction, and electric hoists continue in fair demand, most of the latter going to ice plants recently built or nearing completion. Window lighting is coming in for a considerable amount of sales attention, which has resulted in a very satisfactory volume of orders for the colored-window spotlights, these orders coming from both large and small centers. Lightning-arrester sales are beginning to improve, and prospects are good for the next few months. Jobbers report their March collections as fair to good, with a marked improvement to be noted in the payments by small contractors, and even some municipalities are liquidating their accounts with unusual promptness.

Unsteady Market on Pacific Coast —Collections Better

PRICES have been rather unsteady on the Pacific Coast this week. All copper wires have shown some increase, while steel products have fallen off, boxes showing a decrease of 12½ per cent and tape dropping about 10 per cent. Several carloads of conduit orders for factory shipment are reported, and most of the lines seem unaffected.

General conditions on the Coast are somewhat disturbed. Recent rains have improved the water-power situation, but the spread of the foot-and-mouth disease and the placing of sectional embargoes have affected business. Building permits are still showing increased volume, but there is a lull in electrical construction and employment. Good business is coming from the mining communities. The power companies are continuing their vigorous new-business campaigns. Constructive efforts to educate electrical dealers in better stock methods are producing vastly improved credit and collection conditions. Export conditions are decidedly better.

The Metal Market

THE weakness in prices of the metal market abroad was strongly reflected here during the week, tin being especially hard hit. The decline, which has been particularly evident in the last three days, has caused buyers here to purchase only what metal was required for immediate needs. In the last two or three weeks buying of copper has probably not been equal to the amount of new business placed by manufacturers, so that sales should improve as soon as London prices become more stabilized. Lead is somewhat easier to obtain and zinc, in common with the weakness in the other metals, has fallen off slightly.

NEW YORK METAL MARKET PRICES

	Mar. 19, 1924 Cents per Pound	Mar. 26, 1924 Cents per Pound
Copper, electrolytic	13¼	13¼
Lead, Am. S. & R. price	9.00	9.00
Antimony	11½-11¾	12
Nickel, ingot	26	26
Zinc, spot	6¾	6.65-6.70
Tin, Straits	53¾	51
Aluminum, 98 to 99 per cent	27	27½

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Bates Expanded Steel Truss Building Galvanizing Plant

A new galvanizing plant is now under construction at East Chicago, Ind., for the Bates Expanded Steel Truss Company, Chicago. The plant is thoroughly modern in every respect, all equipment being of the latest and best design. A complete handling scheme is expected to decrease galvanizing cost and materially better shipping service, five overhead electric carriage cranes being provided. It will be possible to handle all sizes of material built by the company in all weights and lengths.

This plant is an entirely new endeavor of the company, all galvanizing heretofore having been done outside. By doing this work in its own plant it will become possible to improve deliveries and give better service, which were the essential reasons for undertaking this project. It is planned to have the plant in operation by June 1.

Electrical Board of Trade of New York to Move

The Electrical Board of Trade of New York will move into new quarters, 5104-5114 Grand Central Terminal Building, 100 East Forty-fifth Street, early in April. The New York Electrical Credit Association will make its headquarters with the Board of Trade but remain under its own management as at present. The Board of Trade hopes as time goes on to have housed under one roof all the local commercial electrical organization activities of the industry.

In the new quarters the Board of Trade is offering to manufacturers wall spaces each 11 ft. x 3 ft. in size for the exhibition of samples to be mounted on a board and suspended. It is announced that many of these spaces have already been sold.

Hastings Electric Sales Organization Expands

The Hastings Electric Sales Company, C. A. Hastings president, formerly the Auto Electric Sales Company, Boston, has moved into a new warehouse at 42 Binford Street, Boston, with 12,500 sq.ft. of floor area, and will henceforth specialize in the warehousing of wiring and other electrical supplies for the convenience of jobbers. The electrical material hitherto carried for the automotive industry will be dropped from the company's lines. In its new location the company will represent the following electrical supply manufacturers: Trumbull-Vanderpoel Manufacturing Company, Bantam, Conn.; Roach-Appleton Manufacturing Company, Chicago; Clifton Manufacturing Company, Jamaica Plain, Mass.; Eastern Tube & Tool Company, Brooklyn, N. Y., and the Carey Ohio Porcelain Company, Carey, Ohio. The Jefferson Electric Manufacturing Company, Chicago, will also be represented at the new location.

Fairbanks, Morse & Company Offering New Stock Issue

The stockholders of Fairbanks, Morse & Company, Chicago, have ratified the plan to issue $12,500,000 7 per cent cumulative preferred stock and to increase the common stock from 325,000 to 375,000 shares. The present outstanding issue of $1,700,000 preferred stock will be retired June 1, 1924, out of funds provided by the company. Three and a half million dollars of the preferred stock is now being offered for sale.

The net profits available for preferred dividends, in the year ended December 31, 1923, after deductions for depreciation and other reserves, were $2,469,547. For the past eight years to December 31, 1923, deducting federal taxes at present rates, the average net profits per annum would be $1,886,100.

Stone & Webster Buy Short-Circuit Calculating Table

What is said to be the first short-circuit calculating table to be purchased by an engineering organization has recently been added to the equipment of the Boston office of Stone & Webster, Inc. The outfit was made by the General Electric Company and is the only one in America containing all the features of the manufacturer's own table as used at the Schenectady works.

Ward Motor Vehicle Company Standardizes Electric Trucks

The Ward Motor Vehicle Company, Mount Vernon, N. Y., is now featuring cradleless models of electric vehicles where the battery is carried above the frame under the driver's seat. Since the beginning of the year the two types of chassis for each model, one with cradle and one without, have been eliminated. The cradleless models are now standardized from the smallest truck up to approximately a 2-ton size, the cradle models beginning with the 2-ton size and continuing up to 7½ tons.

By realigning some of the models and by standardizing on the cradleless model in smaller sizes the number of models has been reduced from fourteen to eight, although the entire range is covered from the smallest to the largest vehicle. With the lowering of production cost a new line of prices was made possible. About half the orders closed since January 15, the date the new models were announced, have been for this type.

Co-operative Electric Cooking Exhibition at Boston

Under the auspices of the Boston *Herald-Traveler* an electric cooking exhibition and school will be held at Horticultural Hall, Boston, during the week beginning April 7, with the co-operation of the Edison Electric Illuminating Company of Boston, the Edison Electric Appliance Company, Inc., the Westinghouse Electric & Manufacturing Company, Landers, Frary & Clark and the Walker & Pratt Manufacturing Company. The exhibition will include the latest types of electric ranges, with daily demonstrations and lectures from 2 to 5 p.m. Each day the exhibits will be thrown open at noon to holders of coupons to be printed in the *Herald-Traveler*. The school was determined upon as a result of the great interest of the public in the electric household service bureau which the newspaper has been running for several months at its offices on Tremont Street. Coincident with the exhibition, non-commercial talks on the place of electric cooking in the modern home will be broadcasted from station "WTAT," Edison Light, Boston, and station "WBZ," Boston and Springfield.

Radio Corporation's Sales Show Large Increase

The great strides made by radio in the past twelve months are reflected in the annual report of the Radio Corporation of America for 1923. The report shows a total of $26,394,789 in gross income for 1923, as against $14,830,856 for 1922. The net income for 1923 is given as $4,737,774, as compared with $2,974,579 for 1922 and $426,799 for 1921. The gross sales of radio receiving apparatus during the year amounted to $22,465,090.

Among the outstanding developments of the year the report cites the opening of two additional radio communication circuits for commercial service. These connect the United States with Italy and Poland, making in all nine channels of international message traffic. The report further says that during the year 1923 there were about 450 radio broadcasting stations in operation in the United States and that there are still many problems to be solved in the broadcasting situation to the solution of which its engineers are devoting themselves.

Scofield-Hendrichs Jobbing House Established at Hartford

An electrical supply jobbing house has been established by the Scofield-Hendrichs Company at 61 Allyn Street, Hartford, Conn., with G. H. Scofield as president and R. E. Hendrichs as treasurer. About 5,000 sq.ft. of warehouse space has been secured, and the company will represent the following manufacturers: American Wiremold Company, Arrow Electric Company, and Hart & Hegeman, Hartford; Harvey Hubbell, Inc., and Connecticut Electric & Manufacturing Company, Bridgeport, Conn.; Rodolitz & Schrier Company, Brooklyn, N. Y.; Halcolite Company and Edwards & Company,

New York; Erskine Glass Company and Star Glass Company, Wellsburg, Va., and Gill Glass Company, Philadelphia.

General Electric Company Sales Expected to Show Decrease

Sales of the General Electric Company for the first quarter of 1924 are estimated at $66,000,000, as compared with $80,010,045 for the first quarter of 1923 and $74,452,442 for the final three months of 1923.

This falling off in sales is, generally speaking, attributed largely to a lull in industrial business. The company is now operating at about 75 per cent of capacity, operations having been curtailed as a result of the decline in orders. However, a resumption of activities is expected which should bring the year's total to the 1923 level.

The Condit Electrical Manufacturing Company, South Boston, Mass., announces the appointment of the following representatives: Shock & Fletcher Supply Company, Birmingham, for Alabama; Ward Engineering & Battery Company, Jacksonville, for Florida, and E. A. Thornwall, Atlanta, for Georgia.

The Western Electric Company announces the appointment of Frank H. Swayze as line-material sales manager. For the past year Mr. Swayze has been directing the pole division of the line-material department.

Sunny Line Appliances, Inc., Detroit, announces that a controlling interest has passed into the hands of F. C. Sebulske, president, under whose management this organization has risen to its present position in the short period of approximately three years.

The Electric Controller & Manufacturing Company, Cleveland, announces that the Boston and New York offices are being combined and W. R. Yorkey, who has been in Boston, will now be district manager of the New York office. A new branch office has also been opened in Philadelphia with H. K. Hardcastle as district manager.

The Westinghouse Electric & Manufacturing Company has opened a branch of the Denver district office in Casper, Wyo., under the supervision of L. V. Fickel.

The Triumph Electric Company, Cincinnati, Ohio, announces that, effective since March 1, there has been a complete revision of prices covering its entire line of motors, both alternating-current and direct-current, from 1 hp. to 250 hp. The new price book is now available to any user of motors.

J. T. Fulwiler, formerly Southern district representative for the General Porcelain Company, has recently opened sales offices at 907 Atlanta Trust Company Building, Atlanta, as manufacturers' agent representing the General Porcelain Company, and J. H. Parker & Son, Inc., Parkersburg, W. Va.; Southern Electrical Equipment Company, Charlotte, N. C., and Sayior Electric & Manufacturing Company, Wheeling, W. Va. The territory covered comprises the states of North and South Carolina, Tennessee, Georgia, Florida, Alabama, Mississippi and Louisiana.

The General Radio Company, Cambridge, Mass., announces the purchase of 20,000 ft. of land adjacent to its present factory and that construction will be started at once on a four-story concrete building. This new unit will have the same capacity as the present building, thus doubling present facilities. Announcement is also made of the appointment of H. T. Greeley, formerly of the advertising staff of the Winchester Repeating Arms Company, New Haven, as advertising manager.

The Moloney Electric Company, St. Louis, is issuing a series of bulletins containing technical and semi-technical information in regard to transformers, their connections, impedance, polarity, etc. The first bulletin of the series is now ready for distribution.

The Eaton Electric Furnace Company, Taunton, Mass., has appointed William H. Williams, Bridgeport, Conn., as Eastern sales representative, with headquarters at Bridgeport.

The Michigan Stove Company, Detroit, manufacturer of cooking and heating appliances, announces that production of a new electric range has been started. A new type of cooking element is being used, permitting cooking vessels to rest directly on the cooking elements, and the oven is lined with "monel" metal.

The A. J. Lindemann & Hoverson Company, Milwaukee, manufacturer of electric heating equipment, will erect a six-story warehouse and office building in Chicago to cost approximately $475,000, according to A. J. Lindemann, president, to take care of the increase in its Chicago business and secure better railroad facilities.

The Cincinnati Storage Battery Company, Moorman Avenue, Cincinnati, has completed plans for the erection of a one-story-and-basement manufacturing plant, 125 ft. x 150 ft., at Stanton and Oak Streets, to cost about $45,000.

The Electrical Engineers' Equipment Company, 710 West Madison Street, Chicago, has plans in preparation for the construction of the initial unit of a new plant on a tract of about 16 acres of land, recently acquired, in the Melrose Park section. It will be one-story, estimated to cost about $125,000. It is proposed to build additional units later.

The E. M. Fay Electric Company, Worcester, Mass., jobber, has moved into new quarters at 181 Commercial Street, where 100 per cent more floor space is available for the company's expanding business. The company has recently become a representative of the French Battery & Carbon Company, Madison, Wis.

The General Electric Company has disposed of its plant at Central Falls, R. I., used until recently by its Rhode Island Glass Division, to the Corning Glass Works, Inc., Corning, N. Y., which will occupy the property for a branch factory. The General Electric Company has removed the equipment from the plant to its Lynn works.

New Equipment Available

Short Descriptions of New Apparatus and Accessory Equipment of Interest to the Electrical Industry and Available from Manufacturers and Announcements of New Lines

Dual-Frequency Super-Calender Drive for Paper Mills

A dual-frequency drive for the super-calendering of paper has been developed by the Westinghouse Electric & Manufacturing Company to eliminate the necessity of using a large gear reduction, the two-motor drive and an overrunning clutch for obtaining the required two speeds, as at present. A single slip-ring motor, designed to have a high torque at the low frequency, drives the lower calender roll through one chain or gear reduction, the other necessary apparatus being a control panel, controller, stop push-button stations, safety switches and a frequency-changer set of the commutator type, together with the required transformers.

The frequency-changer set reduces the primary voltage and frequency to approximately 10 per cent of its normal value, which, when impressed upon the motor, causes it to rotate at approximately 10 per cent of normal speed. This provides the lower or "threading-in" speed on the calender. This connection is obtained through the first step on the controller with all the secondary resistance cut out. The second step disconnects the motor from the low-frequency source, connects it to the high-frequency source and inserts resistance in the rotor circuit. The subsequent steps serve to cut out the secondary resistance in the rotor until full or "running" speed on the motor has been obtained. One of these drives has been on trial at the plant of the Kalamazoo Paper Company, Kalamazoo, Mich., where satisfactory performance and a 25 per cent increase in production have been announced by the management.

Vibrating Screen

A vibrating screen for fine separation of coal, etc., has been developed by the Link-Belt Company. Vibrations of the screen are produced by the action of an unbalanced pulley supported on the screening frame and rotated at high speed. This pulley is unbalanced by weights which can be varied to impart to the main screen box rapid vibrations of proper intensity and direction to screen the different materials. A bushing of special composition is provided for the pulley and automatically oiled by force-feed lubrication, with no other moving parts than the pulley itself.

The screen box is arranged for one, two or three screen decks, depending upon whether two, three or four sizes of material are produced. The screen is arranged for belt drive.

New Trade Literature

EXTENSION TOP AND CROSS ARMS.—The Toledo Cooker Company, Toledo, Ohio, is distributing a leaflet covering the "Toledo" extension top and steel cross-arms.

MOTOR-GENERATOR.—The Ohio Electric & Controller Company, 5900 Maurice Avenue, Cleveland, Ohio, is distributing a folder calling attention to the "Ohio" motor-generators.

EXHAUST FANS.—The American Blower Company, Detroit, has issued a folder describing its "A B C" type "E" exhaust fans for removing long shavings, dust and conveying materials by air.

INSULATOR.—The John G. Dolph Company, Newark, N. J., is distributing a folder covering its "Chinalak" black baking insulator.

SWITCHBOARDS.—Publication No. 471 issued by the English Electric Company, Ltd., Queen's House, Kingsway, London, W.C.2, England, covers its iron-clad truck-type switchboards, class OLZ.

MATERIAL-HANDLING EQUIPMENT.—The Yale & Towne Manufacturing Company, Stamford, Conn., has issued catalog 21-M, covering its hoisting and truck equipment. It also contains much engineering information, including an article on chain-block efficiency. A brief outline of the new line of Yale trucks is given.

TRANSFORMERS.—Bulletin 202-A issued by the Packard Electric Company, Warren, Ohio, describes its "A-W" regulators for control of series street-lighting circuits.

NEW TRANSFORMER STANDARDS.—Preferred ratings and system voltages for distribution transformers, standards for single-phase and three-phase step-up power transformers and the adoption of outdoor construction as standard are among the important new rules in the third edition of "Transformer Standards," issued by the Transformer Section of the Electric Power Club, B. F. Keith Building, Cleveland. The new edition also contains lead markings and vector diagrams, polarity connections, standard ratings, performance specifications, tests, methods of measuring losses and temperature, and all other material which appeared in the previous edition.

LUBRICATION.—"Power Plant Lubrication" is the title of a booklet published by the Tide Water Oil Sales Corporation, 11 Broadway, New York City, which is a treatise covering the latest developments in the lubrication of power-plant machinery. The booklet first covers the theory of lubrication and the testing of lubricants, then takes up in detail the lubrication of the various kinds of bearings, prime movers and auxiliary apparatus. The subject of oil for transformers, oil switches and machine tools and the question of oil filtration are also carefully gone into.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

Purchase and agency is desired in Belfast, Ireland (No. 9,619), for electric equipment for automobiles, electrical novelties (especially sign equipment), radio supplies, wire and wiring supplies.

Purchase is desired in Panama City, Panama (No. 9,628), of electric bulbs.

Purchase is desired in Hongkong, China (No. 9,617), of electrical accessories, such as rubber-insulated wires, cables, flexible lamp cords, electric meters and tumbler switches, fans, irons, heaters, telephones, flashlights and batteries.

Purchase is desired in Canton, China (No. 9,591), of electrical goods.

An agency is desired in Brussels, Belgium (No. 9,618), for electrical supplies, such as lighting, heating, power and kitchen supplies.

An agency is desired in Vienna, Austria (No. 9,614), for small radio receiving apparatus.

Purchase and agency is desired in Dublin, Ireland (No. 9,621), (No. 9,626) and (No. 9,627), for radio receiving sets with two, three and four tubes and parts and accessories.

An agency is desired in Stockholm, Sweden (No. 9,616), for radio supplies.

An agency is desired in Nagoya, Japan (No. 9,613), for electric washing machines.

Purchase is desired in Berlin, Germany (No. 9,615), of chrome-nickel resistance wire.

Purchase is desired in Budapest, Hungary (No. 9,612), of electrically operated machinery for manufacturing needles, safety pins, paper clips, etc.

THE INSTALLATION OF AUTOMATIC TELEPHONES CONSIDERED IN JAPAN.—The installation of automatic telephones to replace the old-style telephone equipment, according to *Commerce Reports*, is under consideration by the Tokyo Telegraph Bureau. Work is under way on rebuilding six of the former central stations. A wireless telephone service between Tokyo station and Kodzu has been under test with satisfactory results. The Railway Department is also considering the installation of wireless at other points to avoid another break in communications such as was caused by the most recent earthquake in January. The value of telephone equipment lost in the earthquake is estimated at 150,000,000 yen (about $75,000,000 at normal exchange), and replacements will probably not be completed before 1925.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

CANDIA, N. H.—At a recent town meeting it was voted to install electric lamps on Main Street. Electricity will be supplied by the Portsmouth (N. H.) Light & Power Company.

PORTSMOUTH, N. H.—Bids will be called at once by the local supply officer, Navy Department, for 6,000 lamp sockets. (N. S. A. F. req. 393.)

HUDSON, MASS. — The Marlborough (Mass.) Electric Company, we are informed, has not submitted a proposal for the purchase of the municipal electric light plant, as stated in these columns in the issue of March 15.

HARTFORD, CONN. — The Hartford Electric Light Company plans to erect a 66,000-volt two-circuit tower transmission line from East Hartford to the Massachusetts State line to connect with the transmission system of the Turners Falls Power Company at Agawam, Mass. A. D. Colvin is general manager.

LITCHFIELD, CONN.—The Litchfield Electric Light & Power Company contemplates the installation of one 150-kva. transformer and rebuilding 8 miles of transmission line during 1924. J. I. West is superintendent.

STAMFORD, CONN.—Plans for the proposed local lace manufacturing plant to be erected by the H. E. Verran Company, 19 Union Square West, New York, to cost about $180,000, include a power house. Lockwood, Greene & Company, 101 Park Avenue, New York, are architects.

Middle Atlantic States

BROOKLYN, N. Y.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until April 8, for fuse elements for the local navy yard. (Schedule 2006.)

CARMEL, N. Y.—The Carmel Light & Power Company contemplates the erection of approximately 6 miles of distribution lines through the farming section during 1924. S. C. Dunning is treasurer and general manager.

GERRY, N. Y.—The Western New York Electric Company, Jamestown, has been granted permission to extend its system into the town of Gerry.

SYRACUSE, N. Y.—The Syracuse Lighting Company is reported to be considering plans for the construction of a steam-operated electric plant, to cost about $250,000.

UTICA, N. Y.—The installation of ornamental lamps on the business thoroughfares is under consideration by the Village Electric Light Commissioners.

BOONTON, N. J.—The Central Jersey Power & Light Company plans to extend its transmission system on the Boonton-Butler Road.

AMBRIDGE, PA.—The Borough Council is considering improvements to the lighting system on Merchant Street. Electrical service is furnished by the Duquesne Electric Light Company, Pittsburgh.

ELDRED, PA.—At an election held recently the proposal to secure electric service for the borough was carried. Work will begin on the erection of the proposed transmission line as soon as the weather will permit.

MINERSVILLE, PA.—The Pine Hill Coal Company plans to install electric power equipment in connection with the rebuilding of its coal breaker and separating plant, recently damaged by fire with loss of about $100,000.

NEW CASTLE, PA.—The City Council has engaged Jones & Carr, consulting engineers, to prepare plans for remodeling the electric lighting system. The street-lighting service is furnished by the New Castle Electric Company.

PATTON, PA.—Bids will be received by the borough of Patton until April 4 for the construction of a 1,500,000-gal. filtration plant, pumping station, electrically driven pumps, etc. The J. N. Chester Engineers, Union Bank Building, Pittsburgh, Pa., is in charge.

PHILADELPHIA, PA.—The Philadelphia Electric Company has filed plans for the construction of a general storage and distribution plant at Market and Twenty-third Streets.

PHILADELPHIA, PA.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until April 8, for 2,000 lb. copper wire. (Schedule 2002.)

PHILADELPHIA, PA.—Bids will be received by the Director of Public Works and the Board of Trustees of the Free Library of Philadelphia, Room 216, City Hall, until April 8 for electric lighting, power and signal system in the Free Library Building, Vine, Twentieth, Wood and Nineteenth Streets. George H. Biles is director of public works.

READING, PA. — A permit has been granted to the Reading Hardware Company for the erection of a power house on Willow Street, to cost about $85,000.

CANNON, DEL. — Local residents are negotiating with the Eastern Shore Gas & Electric Company, Salisbury, Md., to extend its system to Cannon to furnish electricity here.

HAGERSTOWN, MD.—The City Council is considering extending the ornamental lighting system on Summit Avenue to the City Park.

HUNTINGTON, W. VA.—Bids will soon be asked by the United States District Engineer for the construction of a power house at Dam No. 32, Ohio River.

WOODLAWN, W. VA.—The West Penn Power Company is planning to erect a transmission line from Parkersburg to Woodlawn for local service. The Wheeling Electric Company will also extend its line here and make connection with the West Penn system. The last noted company has secured permission to construct a line over the Allegheny River at Springdale, Pa.

CHATHAM, VA.—The Piedmont Power Corporation, recently organized, is planning to construct a transmission line (25 miles long) in this district, to cost about $75,000, with the installation of systems at Chatham and Altavista. R. C. Hunt, Chatham, is secretary.

CHATHAM, VA.—Bids will be received by the City Council until March 31 for equipment for a pumping plant and filtration works for the municipal waterworks, including electrically operated low-service centrifugal pump, directly connected; high-service centrifugal pump, belt drive, and semi-Diesel fuel-oil engine, with starter outfit. The Ambler Engineering Company, Richmond, is engineer.

North Central States

BOYNE CITY, MICH.—The Boyne River Power Company contemplates the construction of a 1,000-kw. steam-operated electric plant for auxiliary service.

BURLINGTON, MICH.—The Consumers' Power Company plans to install a system in Burlington and also at Ithaca, Durand, Burr Oak, Parkville, Lake Harbor and vicinity.

ESCANABA, MICH. — The Escanaba Power & Traction Company and the Escanaba Paper Company are reported to have been consolidated. Plans, it is reported, are being considered by the consolidated company for the installation of additional equipment at the hydro-electric plant at Groos, to cost about $100,000.

FRANKFORT, MICH. — The Benzie County Power Company contemplates extensions to its hydro-electric power plant on the Betsey River, including the installation of additional equipment.

GREENVILLE, MICH.—The R. J. Tower Electric Company will install a 500-kva., 60-cycle, 2,300-volt engine-driven generating unit in its plant. L. W. Green is superintendent.

LUDINGTON, MICH. — The Michigan United Light & Power Company plans extensions to its transmission lines, covering about 18 miles.

CINCINNATI, OHIO.—Bids will be received at the United States Engineer Office, Cincinnati, Ohio, until April 7 for constructing power houses at Dams Nos. 44, 45 and 46 on the Ohio River.

CLEVELAND, OHIO.—The installation of an improved lighting system on Superior Avenue N.E., is under consideration by the Superior Avenue Association.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until April 4 for boilers and ash hoppers, for electric meters, and ornamental "white way" lighting standards for the Division of Light and Power. Separate bids to be submitted on each.

COLUMBUS, OHIO. — Plans are being prepared by the Columbus Railway Light & Power Company for the construction of a power plant in Harrison Township, Pickaway County.

PORT CLINTON, OHIO.—The Northwestern Ohio Railway & Power Company, Oak Harbor, has applied for permission to purchase the property of the Port Clinton Electric Light & Power Company. It is proposed to consolidate the property and extend the transmission lines.

RUSSELLS POINT, OHIO.—The Indian Lake Light & Power Company has petitioned the Public Utilities Commission for permission to issue $25,000 in bonds, of which $18,000 will be used for extensions to power plant at Indian Lake. J. E. Cochran, Russells Point, is interested in the company.

ST. MARY'S, OHIO.—Plans are being considered for extensions to the municipal light and water plant. New equipment, including deep well and centrifugal pumps, will be required.

HARTFORD, KY.—The Kentucky Utilities Company has secured a local franchise and will extend its transmission line here.

HENDERSON, KY. — Extensions are contemplated to the municipal electric plant, to cost about $100,000. New equipment, including generators, etc., will be installed.

LOUISVILLE, KY.—The Louisville Gas & Electric Company is planning an addition to the boiler house at the Waterside plant, to cost about $103,000.

OWENSBORO, KY.—The installation of an ornamental lighting system in the business district, to cost about $12,500, is under consideration.

INDIANAPOLIS, IND.—The Board of Public Works is planning the installation of two-lamp standards to replace the single-lamp units now in use in the downtown section.

INDIANAPOLIS, IND.—Plans are under consideration by the board of trustees of the City Hospital for extensions to the power house in connection with other additions at the hospital, to cost about $250,000. New equipment, including two new boilers, water-softening equipment, etc., will be installed.

CHIPPEWA FALLS, WIS.—At an election to be held in April the proposal to purchase the local power house, substation and electric distribution system of the Wisconsin-Minnesota Light & Power Company, to be owned and operated by the municipality, will be submitted to the voters.

GREEN BAY, WIS.—The Wisconsin Public Service Corporation has applied for permission to extend its rural electric distribution system to furnish electricity in the towns of Suamico, Ashwaubenon, Lawrence and Bellevue.

JEFFERSON, WIS.—The committee appointed by the Council to make investigations of the water and light systems has recommended that the municipal water-power building on the bank of the Rock River be torn down and replaced by a new building.

MILWAUKEE, WIS.—Steps have been taken by the National Avenue Advancement Association for the establishment of a new street-lighting system on National Avenue, West Milwaukee, for a distance of twenty blocks. H. B. Daggett is president of the Village Board of West Milwaukee.

PLATTEVILLE, WIS.—The proposal to install an ornamental lighting system in the downtown section, to cost about $10,000, will be submitted to the voters at the spring election.

RICHLAND CENTER, WIS.—Plans are being considered to build an electric power plant on Bear Valley Creek midway between Gotham and Lone Rock to serve the farmers within a radius of 14 miles and the two villages with electricity. A company capitalized at $25,000 has been organized to build the proposed plant. A. G. Barber is interested in the project.

TWO RIVERS, WIS.—The installation of new equipment in the municipal electric plant and electrically operated pumping machinery in the water plant, to cost about $5,000, is under consideration.

WAUPUN, WIS.—The Council has given its approval of the proposed plan to extend the transmission lines of the municipal electric plant into rural communities to furnish electric service to residents along the Brandon Road.

FARIBAULT, MINN.—The City Council is reported to be considering the construction of a municipal electric light plant.

FERGUS FALLS, MINN.—At an election to be held April 1 the proposal to issue $600,000 in bonds for a power plant will be submitted to the voters.

GREENFIELD, IOWA.—The Council has authorized the submission to voters of a bond issue of $45,000 for extensions to the municipal power plant.

MAPLETON, IOWA.—The Iowa Light, Heat & Power Company has acquired the local electric plant and plans to extend the system.

NEOLA, IOWA.—Plans are being considered for the installation of an additional oil engine in the municipal electric plant in the near future. E. L. Stinn is superintendent.

STATE CENTER, IOWA.—The installation of an ornamental lighting system, consisting of thirty-six posts, is contemplated this year. B. Fridholm is superintendent of the municipal electric plant.

CLARENCE, MO.—The North Missouri Power Company has acquired the municipal electric power plant and plans to extend its transmission line here.

GALLATIN, MO.—The Trenton (Mo.) Gas & Electric Company plans to erect a transmission line from Jamesport for local commercial service. A substation will be installed.

HARTVILLE, MO.—Bonds to the amount of $12,500 have been voted for the construction of a municipal electric plant. The project includes the construction of a dam across the Gasconade River.

KANSAS CITY, MO.—The Kansas City Power & Light Company has filed plans for the construction of a substation at Sixth and Penn Streets, to cost approximately $55,000.

NEW ROCKFORD, N. D.—The Midwest Power Company has preliminary surveys under way for a transmission line from Devils Lake, via Sheyenne, Minnewaukan and Oberon.

KADOKA, S. D.—Steps have been taken to install a new electric lighting system to replace the plant recently destroyed by fire.

GRAINFIELD, KAN.—The City Council is considering the erection of a transmission line and distribution system from Grainfield to Grinnell, to cost about $40,000. A. T. Archer & Company, New England Building, Kansas City, Mo., are engineers.

SMITH CENTER, KAN.—Arrangements are being made by the United Power & Light System of Abiline for the construction of an electric power plant in Smith Center, to cost about $150,000. The company also plans to install an ice-manufacturing plant to supply ice here and to surrounding towns.

TOPEKA, KAN.—Petitions for the installation of ornamental lamps on twenty-two additional blocks, making a total of forty-six blocks this year, have been presented to the City Commission.

Southern States

GRIMES, N. C.—Bids will be received by W. S. Elks, Mayor, until April 1 for the erection of 9 miles of electric transmission line from Washington to Grimesland, to cost about $30,000. E. P. Meredith, Washington, is engineer.

SPRUCE PINE, N. C.—The Norman G. Smith Company, recently organized to mine local clays, plans to install a steam-operated electric plant at the properties. Bids, it is reported, will soon be asked for generators and auxiliary equipment. W. B. Kester is construction engineer.

TAMPA, FLA.—Arrangements are being made by the City Commission for extension to the street lighting in Seminole Heights. The service will be supplied by the Tampa Electric Company.

FORT PAYNE, ALA.—The Fort Payne Light & Power Company has been granted permission to construct a dam and power plant at De Sota Falls, on Little River.

CRAB ORCHARD, TENN.—The Southland Portland Cement Company, Independent Lift Building, Nashville, plans to build a local cement mill, including a power plant. The cost of the plant is estimated at $1,000,000.

DUNCAN, OKLA. — The McCorkle Pipe Line Company, recently organized, is considering installing a series of electrically operated pumping plants in connection with its proposed pipe line from the Duncan oil fields to various points in Texas, covering about 1,700 miles. The cost of the project is estimated at about $1,000,000. R. A. Stuart, Fort Worth, Tex., is head of the project.

WELEETKA, OKLA.—Surveys are being made by the Oklahoma Power Company, Okmulgee, for the erection of a new steam-turbine power plant with transmission lines to surrounding towns. The cost is estimated at about $1,000,000. C. H. Kretz, Okmulgee, is engineer.

WETUMKA, OKLA.—Surveys are being made for a sand filter plant, to be equipped with motor-driven centrifugal pumps, to cost about $65,000. V. V. Long & Company, Colcord Building, Oklahoma City, are engineers.

ATHENS, TEX. — An agreement has been reached between the Athens Power & Light Company and the Texas Power & Light Company whereby the latter will furnish electricity for Athens. Transmission lines are being erected into Athens from Corsicana and a substation is under construction here. Plans are being prepared for an ornamental lighting system for the business district and for the installation of many new street lamps.

CALDWELL, TEX.—The Western Public Service Company, Calvert, has acquired the property of the Caldwell Electric & Ice Company and plans to remodel same. The company has also acquired the plant of the Kosse (Tex.) Light & Power Company and proposes to dismantle same.

DALLAS, TEX.—The City Commission is considering the installation of an ornamental lighting system on Harwood, Young and Live Oak Streets.

ENNIS, TEX.—The Council is considering plans for the construction of a municipal electric plant.

JAYTON, TEX.—The Council is considering a bond issue of $100,000 for the construction of a transmission line from Hamlin and the installation of a local system.

Pacific and Mountain States

ABERDEEN, WASH.—The Grays Harbor Railway & Light Company has petitioned the State Hydraulic Engineer for permission to appropriate waters from the north and east forks of the Quinault River in Jefferson County and to build reservoirs for storing water for hydro-electric purposes.

CASTLE ROCK, WASH.—Application has been filed by Charles Garland, hydro-electric engineer, Tacoma, for a power site for a hydro-electric development on the Cowlitz River above Castle Rock. The project includes a dam over 100 ft. high.

TACOMA, WASH.—Bids will be received at the office of the Commissioner of Light and Water, Tacoma, until April 23 for electrical equipment, consisting of oil circuit breakers, disconnecting switches, switchboards, lightning arresters, coke coils, etc. For details see Searchlight Section.

FALL BROOK, CAL.—The Fall Brook Irrigation Company contemplates installing a series of eleectrically driven pumping

plants in connection with its proposed irrigation projects, to cost about $750,000.

GRASS VALLEY, CAL.—Arrangements have been made by the Nevada County Irrigation District and the Pacific Gas & Electric Company, San Francisco, which will provide for the development of approximately 140,000 ft. of water on the south and middle forks of the Yuba River and its diversion through Lake Spaulding and power plants of the Pacific Gas & Electric Company, involving an expenditure of about $8,000,000. After passing through power plants it will be returned to the Nevada County Irrigation District for irrigating purposes. The work will include the erection of power houses at Lake Spaulding plant, enlarging Drum power plant, distribution system, canals, ditches, etc.

MARYSVILLE, CAL.—The Pacific Gas & Electric Company has appropriated $19,200, for the reconstruction of the transmission line to Yuba City.

MODESTO, CAL.—The board of directors of the Turlock Irrigation District has entered into a contract with the officials of the San Joaquin Light & Power Company for the sale of surplus energy generated at the Don Pedro dam for a period of fifteen years.

ONTARIO, CAL. — The Ontario Power Company plans to construct a 4,000-kw. steam-operated power plant.

SACRAMENTO, CAL.—The Great Western Power Company plans to erect a transmission line, about 11 miles, in the Carmichael Public Utility District.

SAN FRANCISCO, CAL.—Bids will be received by the Board of Public Works until April 2 for transmission line fittings for the Hetch Hetchy Mocassin Creek power station, including standard suspension cable clamps for copper and aluminum lines, heavy-duty suspension clamps, dead-end clamps, suspension hooks, etc.

VACAVILLE, CAL.—The Pacific Gas & Electric Company has authorizeed plans for extensions to its Vaca-Dixon substation to cost $852,800, including the installation of a third unit to handle the 100,000 hp. soon to be available from the Pit River No. 3 development.

WEIPPE, IDAHO—The Cœur d'Alene Mill Company is planning to build a new sawmill and power house, to cost about $70,000.

AJO, ARIZ.—Plans are under consideration for the installation of a street-lighting system in Ajo. Electrical service is furnished by the Ajo Improvement Company.

MILES CITY, MONT.—The Chicago, Milwaukee & St. Paul Railroad Company, Chicago, contemplates the construction of a local power plant, to cost about $50,000.

RYEGATE, MONT.—The installation of electrically operated pumping machinery in connection with the proposed Franklin irrigation project is under consideration by the Commissioners of Golden Valley County.

CANON CITY, COLO.—The Southern Colorado Power Company for extension to its local plant, to cost about $85,000.

IGNACIO, COLO.—Bids will be received by the United States Indian Service, Consolidated Ute Agency, until April 1, for a quantity of electrical supplies, including lighting fixtures, copper wire, flexible conduit, porcelain cleats, cross-arms, cross-arm braces, rotary surface switches, friction tape, etc.

LAS CRUCES, N. M.—The installation of an ornamental lighting system in the business district is under consideration.

Canada

COLEMAN, ALTA.—A bylaw has been approved by the ratepayers authorizing an expenditure of $100,000 for new water and light equipment.

WINNIPEG, MAN.—Plans are being considered by the provincial government for extending the transmission lines of the Manitoba Power Commission from Morden to Gretna. The cost is estimated at $50,000.

WESTON, ONT.—The Town Council has authorized extensions to the Hydro-Electric system in Weston and North York Township, to cost about $25,000.

COATICOOK, QUE.—The Southern Canada Power Company, Ltd., is considering the purchase of the municipal electric plant and contemplates improvements to same.

PRINCE ALBERT, SASK.—Bids will be received by E. F. Webb, City Clerk, until May 15, for furnishing and installing one 1,500-kw. steam-turbine generator and condenser complete at the municipal electric light plant. For details see Searchlight Section.

Electrical Patents

Announced by U. S. Patent Office

(Issued March 4, 1924)

1,485,994. PROTECTIVE INSULATING SLEEVE; M. B. Salisbury, Chicago, Ill. App. filed Dec. 21, 1922. For incasing electrical conductors to protect linemen and others from shock.

1,485,998. ELECTRIC CURRENT CONTROLLER; G. O. Wilms, Milwaukee, Wis. App. filed July 12, 1920. Compression-pile type.

1,486,042. GALVANIC ELEMENT; R. Schuster, Berlin-Halensee, Germany. App. filed Aug. 25, 1923. Using two electrolyte fluids of special composition and with two electrodes of carbon and of zinc respectively.

1,486,049. WIRELESS TELEGRAPH AND TELEPHONE INSTRUMENT; G. B. Spring, Milford, N. H. App. filed Oct. 21, 1922. Circuit-completing device for completing the aërial or ground circuit of receiving instruments using the human body by means of headsets.

1,486,069. GALVANIC ELEMENT; A. Adams, Macon, Ga. App. filed Aug. 25, 1923. Of the dry-cell type.

1,486,081. SOUND-PRODUCING DIAPHRAGM; H. Fischer, New York, N. Y. App. filed Oct. 24, 1922. For use in telephones or talking machines to product the lower notes of the musical scale in more correct proportionate volume.

1,486,085. AMMETER; P. M. Gelatt, La Crosse, Wis. App. filed May 23, 1922. Plunger type, for use on motor vehicles.

1,486,109. ELECTRIC TRANSFORMER; B. W. David, Cleveland, Ohio. App. filed April 5, 1922. Amplifying transformer for use with radio receiving apparatus.

(Issued March 11, 1924)

15,793 (reissue). AUTOMATIC FIRE ALARM; W. J. Luse, New York, N. Y. Original application filed Nov. 20, 1918. Using a phonograph, telephone and a fusible-link device to operate.

1,486,124. STORAGE-BATTERY CONSTRUCTION; C. H. Bong and C. P. Sorensen, Chicago, Ill. App. filed Aug. 4, 1921. Avoids lead burning and the use of compound for sealing.

1,486,132. TELEPHONE TRANSMITTER BUTTON; H. C. Egerton, Maplewood, N. J. App. filed Sept. 14, 1920. Carried on the back of the diaphragm proper.

1,486,134. MEANS FOR TRANSMITTING SIGNALS FOR WIRELESS TELEGRAPHY; H. Gerdien, Berlin-Schmargendorf, Germany. App. filed Nov. 30, 1921. Using a self-induction with an iron core in the antenna circuit and exciting the core from a separate continuous-current source.

1,486,136. INDICATOR; R. E. Hall, Chicago, Ill. App. filed Jan. 8, 1920. Wherein relatively minute physical movements are to be mechanically transmitted and reproduced but enlarged.

1,486,172. PRIMARY BATTERY; H. Wilhelm, Brooklyn, N. Y. App. filed March 22, 1920. Of dry-cell type; zinc foil rolled around cartridge instead of using a cup.

1,486,209. AIR-PRESSURE ALARM DEVICE FOR PNEUMATIC TIRES; L. F. Wesche, Webb, Iowa. App. filed Aug. 24, 1921. Circuit closer for actuating a buzzer or similar alarm.

1,486,221. MEANS FOR CONTROLLING THE FLOW OF ELECTRONS IN ELECTRIC DISCHARGE DEVICES; E. Berry, Buenos Aires, Argentina. App. filed March 5, 1921. Used in the reception of wireless signals.

1,486,237. THERMIONIC DEVICE; J. A. Fleming, London, England. App. filed Nov. 6, 1919. Vacuum bulb used as detector of electric oscillations.

1,486,238. ELECTRICAL MEASURING INSTRUMENT; L. E. France, Cleveland, Ohio. App. filed Aug. 18, 1919. Particularly for use on motor vehicles.

1,486,250. ELECTRIC CONNECTION; M. C. King, Chicago, Ill. App. filed Sept. 26, 1921. Where a soft metal such as lead is used, as on a storage-battery terminal.

1,486,314. ELECTRIC FLATIRON; A. E. Waggoner, Chicago, Ill. App. filed April 14, 1919. With an indicator to show whether element is at red heat or not.

1,486,319. LAMP SHADE AND MEANS FOR MOUNTING THE SAME; A. Bostroem, New York, N. Y. App. filed Nov. 23, 1920. Adjustable and removable.

1,486,332. STREET-INDICATING DEVICE; J. F. Halverson, Madison, Wis. App. filed Oct. 10, 1921. Automatic, for use on street cars, etc.

1,486,379. SPEED-INDICATING SIGNAL; M. Jackson, Portland, Ore. App. filed Feb. 11, 1922. In which a variety of colors of light indicate various speeds at which a vehicle may be traveling.

1,486,386. ELECTRIC CONTROLLER; N. B. Laing, Detroit, Mich. App. filed Jan. 17, 1923. Reversible with dynamic braking in both directions for direct-current motor.

1,486,398. STORAGE BATTERY; G. F. Townsend, Oankland, Cal. App. filed Oct. 6, 1921. Lead type, using a narrow plate and separators of minimum area.

1,486,410. DIRECTION INDICATOR FOR MOTOR-DRIVEN VEHICLES; G. P. Bagnall, Los Angeles, Cal. App. filed Feb. 5, 1920.

1,486,412. ELECTRIC BED WARMER; R. W. Biddlecom, Glendale, Cal. App. filed Jan. 29, 1923. Using an incandescent electric light globe as heat-generating element.

1,486,430. ELECTRIC ACCUMULATOR; K. Hansen, Copenhagen, Denmark. App. filed Nov. 5, 1921. Lead type.

1,486,432. SUPPORT FOR FILAMENTS IN THERMIONIC VALVES AND OTHER TUBES; B. Hodgson, Portsmouth, and S. R. Mullard, Southfields, London, England. App. filed Aug. 22, 1921.

1,486,434. STORAGE BATTERY; R. J. Holden, Fort Morgan, Col. App. filed April 1, 1922. Cell container.

1,486,505-1,486,506. STABILIZING OSCILLATION GENERATORS; K. W. Wagner, Berlin, Germany. App. filed June 28, 1923. Utilized with a tuned or untuned load.

1,486,546. ELECTROLYTIC SEPARATION; B. E. F. Rhodin, Atlantic City, N. J. App. filed May 26, 1922. As practiced in the manufacture of magnesium, sodium and potassium.

1,486,560. GROUNDING CLAMP FOR ELECTRIC WIRES; R. A. Becker, Poughkeepsie, N. Y. App. filed June 22, 1921. Wire wound in spiral form in a clamping device and clamped to pipe.

1,486,568. ELECTRIC LAMP SUPPORT; L. H. Debs, Chicago, Ill. App. filed May 3, 1922. For lamp fixtures.

1,486,576. RECORDING AND SIGNALING MECHANISM; G. M. Hafer, Detroit, Mich. App. filed Sept. 14, 1921. For indicating and recording the strength of an electric current passing through a galvanometer.

1,486,613. ELECTRIC BATTERY; E. A. G. Levallois-Perret, France. App. filed June 30, 1922. Primary type, capable of concentrating and localizing the precipitates and insoluble products formed in operation.

1,486,628. STARTING AND IGNITION SYSTEM; A. E. Buchenberg, Toledo, Ohio. App. filed May 21, 1910. For an internal-combustion engine whereby the reluctance of the magnetic circuit of the induction coil is reduced whenever the circuit of the starting motor is closed.

1,486,645. SOCKET FOR ELECTRIC LAMPS OR FUSES; R. Eberhardt, New York, N. Y. App. filed March 30, 1923. For quickly attaching the bulb or fuse plug to the threaded sleeve.

1,486,648. INDUCTION COIL; W. A. Evans, Fort Washington, Pa. App. filed Dec. 31, 1919. With primary winding in two coils between which is the secondary, where neither finding is overlaid by the other.

1,486,675. REVERSE-CURRENT CONTROLLER; W. C. Nein, New York, N. Y. App. filed March 15, 1920. For use in ignition system to prevent demagnetization of magnets, etc.

1,486,691. ELECTRIC CONNECTOR; E. Schwartz, New York, N. Y. App. filed Sept. 7, 1918. Detachable for connection to flatiron, etc.

1,486,693. INCANDESCENT LAMP SOCKET; I. R. Seltzer, Waterbury, Conn. App. filed May 7, 1921.

1,486,726. RECUPERATION CELL; C. F. Buffard, Paris, France. App. filed Sept. 9, 1922. Renewable type, with constant discharge rate.

1,486,735. APPARATUS FOR PRODUCING AND RECEIVING SIGNALS; R. A. Fessenden, Brookline, Mass. App. filed Aug. 15, 1918. Submarine signaling and detection of submarines and similar bodies.

1,486,778. MEANS FOR CASTING PIPE; J. R. McWane, Birmingham, Ala. App. filed Oct. 18, 1922. In a horizontal position.

1,486,790-1,486,791 — SEPARABLE ATTACHMENT PLUG; N. W. Nutt, Trenton, N. J. App. filed Sept. 1, 1921.

1,486,803. METHOD OF CONNECTING STORAGE BATTERIES FOR ELECTROLYTIC FORMATION; F. D. Ruckman, Cleveland, Ohio. App. filed Jan. 17, 1921. Means for securing electrical conductors to the terminals.

1,486,815. ELECTRIC FITTING; J. T. Trotter, Brooklyn, N. Y. App. filed April 28, 1922. For electric lamps made in imitation candles.

1,486,840. ELECTRIC LANTERN; H. B. Patche, Kansas City, Mo. App. filed June 19, 1922. Primarily for railroad use.